TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED THREE

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-second Annual Meeting

JULY 21, 22 AND 23, 1903,

At Woods Hole, Mass.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
1903.

Officers for 1903-1904.

President.....FRANK N. CLARK, Northville, Mich.
Vice-President.....DR. TARLETON H. BEAN, St. Louis
Recording Secretary.....GEORGE F. PEABODY, Appleton, Wis.
Corresponding Secretary, W. DE C. RAVENEL, Washington, D. C.
Treasurer.....C. W. WILLARD, Westerly, R. I.

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C. C. WOOD, Plymouth, Mass.
R. D. HUME, San Francisco, Cal.
M. E. MERRILL, St. Johnsbury, Vt.
J. L. LEARY, San Marcos, Tex.
E. A. TULIAN, Leadville, Colo.

PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Tuesday, July 21st, 1903.

Convention called to order at 12 m. by the President, Mr. George M. Bowers, of Washington, D. C.

The registered attendance at the meetings of the Society is as follows:

Allen, George R., Roxbury, Vt.
Atkins, Charles G., East Orland, Me.
Bean, Hon. Tarleton H., St. Louis, Mo.
Beeman, Henry W., New Preston, Conn.
Bentley, B. Court, Westerly, R. I.
Blatchford, E. W., Chicago, Ill.
Boardman, W. H., Central Falls, R. I.
Bower, Seymour, Detroit, Mich.
Bowers, George M., Washington, D. C.
Bowman, W. F., Woods Hole, Mass.
Bryant, Edwin E., Madison, Wis.
Carter, E. N., St. Johnsbury, Vt.
Champlin, John H., Westerly, R. I.
Clark, Frank N., Northville, Mich.
Corliss, C. G., Gloucester, Mass.
Davis, E. A., Bethel, Vt.
Dean, H. D., Neosho, Mo.
Downing, S. W., Put-in-Bay, O.
Gorham, F. P., Woods Hole, Mass.
Graham, A. R., Berkeley, Mass.
Gray, George M., Woods Hole, Mass.
Green, Chester K., Washington, D. C.
Geer, E. Hart, Hadlyne, Conn.
Handy, L. B., South Wareham, Mass.
Harron, L. G., Washington, D. C.

Henshall, J. A., Bozeman, Mont.
Hubbard, Waldo F., Nashua, N. H.
Hurlburt, H. F., East Freetown, Mass.
Jennings, G. E., New York, N. Y.
Jones, Alexander, Erwin, Tenn.
Lane, George F., Silver Lake, Mass.
Leary, J. L., San Marcos, Tex.
Locke, E. F., Woods Hole, Mass.
Lydell, Dwight, Mill Creek, Mich.
Marsh, M. C., Washington, D. C.
Mathewson, G. T., Thompsonville, Conn.
Millikin, Dr. J. D., U. S. Fish Com., Woods Hole, Mass
Morton, William P., Providence, R. I.
Nevin, James, Madison, Wis.
Peabody, George F., Appleton, Wis.
Pike, Robert G., Middletown, Conn.
Race, E. E., Green Lake, Me.
Ravenel, W. DeC., Washington, D. C.
Robinson, Robert K., White Sulphur Springs, W. Va.
Root, Henry T., Providence, R. I.
Seagle, George A., Wytheville, Va.
Smith, Capt. J. A., Woods Hole, Mass.
Stone, Livingston, Cape Vincent, N. Y.
Thompson, W. T., Nashua, N. H.
Titcomb, John W., Washington, D. C.
Tulian, E. A., Leadville, Colo.
Waterhouse, Everett Marshall, Providence, R. I.
Whish, John D., Albany, N. Y.
White, R. Tyson, New York City.
Willard, C. W., Westerly, R. I.
Wires, S. P., Duluth, Minn.
Wood, C. C., Plymouth, Mass.
Worth, S. G., Edenton, N. C.

During the several sessions the following gentlemen were elected to membership in the Society:

Atwood, Anthony, 75 Waterest Street, Plymouth, Mass.
Bastedo, S. T., Toronto, Canada.

Beardsley, A. E., M. S., Greeley, Colo.
Beason, W. H., Nashua, N. H.
Bennett, Charles P., Secretary of State, Providence, R. I.
Bense, W. E., Port Clinton, Ohio.
Bentley, B. Court, Westerly, R. I.
Bogle, C. M., Editor Pacific Fisherman, Seattle, Wash.
Bowman, W. F., Breakwater Hotel, Woods Hole, Mass.
Britton, F. H., St. Louis, Mo.
Campbell, S. H., Laramie, Wyo.
Champlin, John H., Westerly, R. I.
Chandler, Horatio, Kingston, Mass.
Clark, Charles C., General Treasurer Office, Providence, R. I.
Clark, Walton F., Westerly, R. I.
Cone, Moses H., Flat Top Manor, Bowling Rock, N. C.
Degler, F. A., Cheat Bridge, Randolph County, W. Va.
Ferry, C. H., Room 1720 Old Colony Building, Chicago, Ill.
Goldsborough, E. L., U. S. F. C., Washington, D. C.
Gordon, Jack, Paris, Tex.
Graham, A. R., Berkeley, Mass.
Grant, R. P., Clayton, N. J.
Gray, George M., Woods Hole, Mass.
Guard, J. E., Bullochville, Ga.
Harron, L. G., U. S. F. C., Washington, D. C.
Hayes, J. R., Detroit, Mich.
Hobart, T. D., Pampa, Gray County, Tex.
Hume, R. D., 421 Market Street, San Francisco, Cal.
Ingraham, E. W., Oil City, Pa.
Isaac, George H., U. S. F. C., Washington, D. C.
Jewett, Stephen S., Laconia, N. H.
Johnson, M. D., F. M., 117 Beacon Street, Boston, Mass.
Johnson, George H., Riverside, R. I.
Johnson, R. S., Manchester, Iowa.
Knight, Prof. A. P., Queens University, Kingston, Can.
Lambert, E. C., Manchester, N. H.
Lambson, G. N., U. S. F. C., Baird, Colo.
Latchford, Hon. F. R., Toronto, Canada.
Lewis, C. C., U. S. F. C., Washington, D. C.
Mahone, A. H., White Sulphur Springs, W. Va.

Marshall, F. M., Washington, D. C.
McDonald, A. G., care A. Booth & Co., Detroit, Mich.
McDougal, J. M., Gunnison, Colo.
Parker, J. Fred, Assist. Secretary of State, Providence, R. I.
Purdum, James, K. P. P., Woods Hole, Mass.
Race, E. E., Green Lake, Me.
Randall, G. W., Plymouth, Mass.
Reed, C. A., Santa Cruz, Cal.
Rhodes, G. W., Lincoln, Neb.
Ripple, Robert, Woodruff, Wis.
Robinson, Robert K., White Sulphur Springs, W. Va.
Rooney, James, Ft. Stockton, Tex.
Sherwood, George H., American Museum, New York City.
Shurtleff, Merrill, Lancaster, N. H.
Simmons, Walter C., Providence, R. I.
Slade, George P., 309 Broadway, New York City.
Stevens, Arthur F., 227 West Grand Street, Elizabeth, N. J.
Stone, Arthur F., St. Johnsbury, Vt.
Teal, J. N., Portland, Oregon.
Thomas, H. G., Stowe, Vt.
Thompson, William H., Alexandria Bay, N. Y.
Tucker, Dr. Ernest F., The Marquam, Portland, Oregon.
Turner, Avery, Amarillo, Tex.
Veeder, John J., Woods Hole, Mass.
Wallich, Claudius, U. S. F. C., Oregon City, Oregon.
Walsh, Joseph, Woods Hole, Mass.
Warner, S. M., Glen Farm, Dorset, Vt.
Waterhouse, Rev. E. M., Providence, R. I.
Wolf, Herman T., 489 The Bourse, Philadelphia, Pa.
Worth, S. G., Edenton, N. C.
Wride, George A., Grindstone City, Mich.
Wykoff, C. F., 280 Broadway, New York.

President Bowers: Gentlemen, you are now called to order. The usual formalities will be dispensed with. I hardly think under the conditions that it is necessary to have any one to induct the present president into office, as in the absence of Gen. Bryant it will be necessary to postpone that event at least.

The President then read his address, which is as follows:

Washington, D. C., July 17, 1903.

Members of the American Fisheries Society:

Gentlemen:—

As President of this Society I greet you and wish you well, and as the head of the Bureau of Fisheries I welcome you to Woods Hole and this building where you are met. To address you thus in dual capacity and in this place, made memorable by former successful meetings and by its association with the name which we all honor and to which we shall this year pay visible and enduring tribute, is a compliment which I appreciate and value.

It is an honor significant of the relations which have always existed between this Society and the Fish Commission. The two are twin brothers of the fisheries conditions of thirty-two years ago and the enthusiasm and hopefulness with which they were met. At that time it had become increasingly obvious that some of our fisheries were being depleted to a degree which would soon make futile their further pursuit for sport or profit. It was clear that man had destructively disturbed nature's pre-existing balance and that man alone would re-establish it. Both among those directly interested in the fisheries by reason of the sport or profit derivable from them and in legislative bodies, the adoption of systematic and vigorous measures for the restoration of the fisheries was gaining advocates.

There was existent in the country at that time a little body of progressive men, similar in character to that which now constitutes the membership of this Society, who saw clearly and acted wisely. Some of them, appreciating fully the value of an organization holding stated meetings for the exchange of experience and information, formed themselves into this Society which has since its founding held a high place in the annals of American fish culture and all that makes for the good of the fisheries. At the same time the general agitation of the subject and the representations of Professor Baird secured from Congress the appointment of a commissioner and a small appropriation for the purpose of carrying on certain investigations upon the causes of the decrease of fishes and remedies therefor. One of the earli-

est acts of this Society was to aid in procuring increased appropriations for this purpose, and from that time to this the American Fisheries Society and the United States Fish Commission have been in close and mutually profitable relations.

It was fortunate for the Fish Commission that there was available at the time of its inception a master mind whose breadth, learning, and disinterestedness had the respect of all interested in the work of rescuing the fisheries from the conditions in which they were sinking. With a reputation already world-wide, and securing and assuming as a labor of love the burden of organizing and directing the new Commission, no taint of self-seeking could be attributed to his efforts at that time. Fish culture was not yet divested of its novelty and skepticism was still unallayed. Scientific knowledge was less extended than now and but little accurate knowledge was attainable concerning the fisheries and the conspicuous conditions upon which they depended. To the acquirement of such information, to the demonstration of the value of fish culture on a large scale, the peculiar development and extension of improved methods, Professor Baird devoted himself, and he was ably assisted by this Society as a whole and by some of its members individually. Professor Baird's administration was long and able, and under him the Commission passed through infancy to advanced knowledge and sturdy manhood which received the respect and admiration of the world.

Since the foundation of these two organizations the United States has taken a conspicuous place in all matters relating to the fisheries, and American methods and investigations are recognized as criteria for foreign emulation, study and profit. Hatcheries have multiplied and improved and the fisheries work of the Federal Government has grown beyond the hopes and expectations of its projectors. Congress has pursued a liberal policy, and while all that has been asked for has not been granted, the experience of the past five years indicates that the work which is being carried on meets with the approval of Congress and their confidence is expressed in increased appropriations. President Roosevelt's interest in all that pertains to the work in which this Society and the Bureau of Fisheries is engaged is well known and is a stimulus to governmental activities in these lines. Secretary

Cortelyou is also favorably disposed and it is assured that the good work independently carried on under the Fish Commission in the past will be continued and extended under its new status as the Bureau of Fisheries of the Department of Commerce and Labor.

During the past year the Fish Commission, in addition to its usual extensive fish-cultural operations, is credited with important investigations in Hawaii, Alaska, and in the several parts of the United States. Experiments are now under way, or about to be undertaken, which it is believed will lead to the development of practical methods of culture of sponges, terrapin, green turtle, and frog, and improvement in the methods of oyster culture. At the present time there is in course of erection a station to be devoted to the lobster and lobster culture, according to a system developed jointly by the Fish Commission of the United States and the Rhode Island State Fish Commission.

In the past thirty-two years much has been done but much remains. The possibility for originating investigations in fish culture and its cognates are not yet exhausted. An accurate knowledge of causes and diagnoses of the treatment of diseases which attack fish in confinement is urgently needed, and, as you have been made aware by the paper presented last year and the one announced for the present meeting, this problem is now being systematically attacked. Another need is the study of nutrition of young fishes and the development of a more rational method of feeding. Intensive production of the natural food of certain species is in places almost a necessity and the discovery and development of a cheap and practical system is highly desirable A score of other desiderata might be mentioned and they will suggest themselves to those of you who are practically engaged in fish culture or research. It is a stimulus to such research and investigations that this Society and these meetings are chiefly valuable.

We have an interesting and instructive program, from the consideration of which I shall no longer detain you. I trust that this meeting will be pleasant and profitable and that we shall go from it fortified to carry to greater perfection the various works upon which we are severally engaged.

(The address was received with great applause.)

President: In the absence of the chairman and treasurer of the committee in charge of the memorial services concerning the unveiling of a memorial to Prof. Baird, I deem it proper at this time that a committee should be appointed by the American Fisheries Society to assume and take control of this whole matter. I therefore suggest that Mr. Frank N. Clark, and Mr. W. De C. Ravenel, and Mr. E. F. Locke, be named as members of that committee, subject to the approval of the Society.

Secretary: I have a letter from Mr. Blackford in which he says: "I am so ill this week that I can hardly write intelligibly," and he apologizes for not being able to be present, and has turned over the matter of the memorial services entirely to this meeting, and encloses a check which might perhaps be considered later, for a balance that has inured.

President: I found, in looking over some memoranda of Dr. Smith's, that arrangements had been made with Prof. Brooks of Johns Hopkins University to deliver this address, and I communicated with Prof. Brooks a week or so ago, and he gave me to understand that he would be here tomorrow. It would be necessary, however, under a previous arrangement made with Dr. Smith, for the Society to defray his expenses. I think that was the arrangement.

Secretary: That is the understanding.

President: That is, out of the memorial fund already provided for?

Secretary: Yes, and whatever money is left will probably inure to the coffers of the American Fisheries Society.

Mr. Titcomb: I move that we take up as the next business, the naming of the various committees usually appointed, and add to those of last year, a committee on program, the duty of that committee to be to arrange for time of meetings, and the time for recreation, which will go with the meetings hand in hand. As many of you know, we can hold meetings while we are on the boat, going to any place we wish to visit; and some of the proprietors of commercial hatcheries here, desire the Society to visit their places.

Another committee I would suggest, is a committee on papers, who should receive the papers, ascertain just how many there are besides those that are on the printed program, and ar-

range for the order of reading, so that it can be annouced in advance, giving those who have special interest in one line of work an opportunity to be present at that meeting, if they cannot attend all. In making these motions I request you to omit me from any of those committees.

President: Your suggestion is a good one, but I had intended that the committee just appointed should be the committee on program, and if there be no objection it will be so considered.

Mr. Titcomb: That is entirely satisfactory.

President: In regard to the committee on papers, I will put that motion.

(Unanimously carried).

The President appointed on that committee Mr. Titcomb, Dr. Bean, and Mr. Seymour Bower.

The following telegrams were received and greeted with applause:

Washington, D. C., July 21.

To Hon. George M. Bowers, President,
Society of Fisheries.

Accept for yourself and your associates my best wishes for a most interesting and successful meeting.

GEORGE B. CORTELYOU, Secretary,
Department of Commerce and Labor.

Boston, Mass., July 21.

To Commissioner of Fisheries,
Woods Hole.

Will be at Woods Hole this afternoon. W. K. BROOKS.

The Secretary's report was then called for.

Secretary: The Secretary's report is embodied in the transactions for the last year, and the only report that the Secretary has to make in addition is that during the year the work of the Secretary has been very much helped by the United States Fish Commission in furnishing a list of some 400 names of eligible candidates for membership, to whom a circular letter has been sent, and we have added approximately about fifty new members who have sent in their request for membership, and usually with a very grateful acknowledgement of the courtesy of the invitation extended to them; and some of them will be here I think. There is nothing new that the Secretary has to report, except to turn

over to the Society a number of letters from different parts of the country from those who acknowledge the value of this Society, its work and influence, and wish it Godspeed. I do not think there is anything else that the Secretary has to report. The treasurer reports the amount of money received from these new members.

(Secretary's report accepted).

Treasurer's report called for, which was presented as follows, read, and at Mr. Willard's request referred to the auditing committee, after being received:

To the American Fisheries Society
of the United States of America:

Gentlemen:—

I herewith submit my annual report as Treasurer from August 5th, 1902, to July 21st, 1903:

RECEIPTS.

Balance in treasury	$101.14	
Yearly dues and admission fees	278.00	
Life membership dues	30.00	
Interest on balances	1.50	
		$410.64

EXPENDITURES.

1902.			
Aug. 12.	New ledger	$ .75	
Aug. 12.	300 stamped envelopes	6.36	
Aug. 22.	100 stamped envelopes	2.12	
Oct. 10.	100 stamped envelopes	2.12	
Sept. 16.	H. D. Goodwin, stenographer	102.00	
Dec. 3.	Post Publishing Co. (By Secretary)	152.60	
Dec. 3.	G. F. Peabody, Secretary	27.83	
1903.			
May 27.	Receipts	.75	
May 27.	100 stamped envelopes	2.12	
June 27.	Receipt books and Ex.	5.75	
June 29.	100 stamped envelopes	2.12	
July 17.	George F. Peabody, Secretary	43.47	
		$347.99	
Balance cash on hand		62.65	
			$410.64

Depository of funds, Manufacturers Trust Company, Providence, R. I.

C. W. WILLARD, Treasurer.

Westerly, R. I., July 21st, 1903.

Secretary: I would like to bring up a matter now perhaps for the meeting to decide upon. I think that whoever occupies the position of secretary next year, should have an appropriation for the expenses of the office. There is a great deal of clerical work, and very few men have the time to give it, if they have anything else to do, and my stenographer has spent so much extra time at it, that I have paid her $25 extra each year, which I am glad to contribute, but I think it is well that no one should be burdened with that, and I think there should be as large an appropriation as that to pay for the extra work, of which there is a great deal. I have sent out nearly 250 letters relating to the business of the Society. During the last year I had quite a large correspondence, receiving letters constantly, and my stenographer has had that extra work, besides the editing of the report, and it is quite a task too for the Secretary to collate all the material, and do the proof reading and all that sort of thing, and I would respectfully suggest and move that the Society appropriate a sum not less than $25 to the Secretary to pay his expenses.

Motion seconded and unanimously carried.

Secretary: It is understood that this is not retroactive, but for the future.

President: That will be understood.

The President then appointed the following committees:

Committee of five on nomination of officers: Mr. Seymour Bower, Dr. J. A. Henshall, Mr. E. N. Carter, Mr. R. T. White, and Mr. John D. Whish.

Committee of three on time and place of next meeting: Mr. John W. Titcomb, Mr. W. P. Morton, and Mr. John L. Leary.

Auditing committee: Mr. S. G. Worth, Mr. H. D. Dean, and Mr. W. H. Boardman.

Mr. Titcomb: I can bring in some specimens of bass to start the bass question, if you wish me to do so. I have no paper on the subject.

Mr. F. N. Clark: Do not start the bass question now before dinner. (Laughter).

If you will allow the committee on program to confer, we will submit a program to you before you adjourn.

Mr. Titcomb: The committee on time and place will be very glad to hear from all those who are interested in that question, at any time after this meeting.

For the committee on papers, I will request all those who have papers to submit them to us as soon as convenient, so that the various subjects can be arranged to come together.

Mr. Charles G. Atkins: Do I understand that Mr. Titcomb desires to have the manuscripts submitted?

Mr. Titcomb: We would be glad to see them.

Mr. Clark: The program committee feel they have not time to prepare a complete program at this time, and therefore beg leave to submit the following partial report, in regard to the program for today, and this evening will submit a full report of the program for the several days doings, including the memorial exercises. We suggest that the Society meet at 2 o'clock on the Fish Hawk, and for an hour take up the papers on bass and discuss them, and that at 5 o'clock adjourn for evening dinner, to meet again at 8 o'clock in this room for further discussion of the bass papers (if they have not been completed), and then take up the trout papers.

Report unanimously accepted.

Secretary: I suggest that the report be typewritten and posted.

Mr. Clark: That will be done.

Recess until 2 p. m.

AFTERNOON SESSION, 2:30 O'CLOCK.

Same day, 2:30 p. m., meeting called to order by the President on board the Fish Commission steamer, Fish Hawk.

Roll was called and applications for membership read by Mr. Willard.

Mr. Clark: I move that the names read be elected as members of this Society.

Motion seconded and unanimously carried.

Mr. Clark: The committee on program desire to suggest a change in the program. You will remember, they suggested that papers on the bass question be discussed here on the boat, and

as that is a very important subject the committee have decided that on account of the difficulty of discussing these papers on the deck of the boat, it will be better to change the program in that respect, and that papers by Dr. Bartlett on "Angling for Carp," and Mr. Mead, of Providence, Rhode Island, on "Recent Advancement in Lobster Culture," be taken up now. We think the question of bass could be better discussed later.

President: If there are no objections it will be taken as the sense of the meeting that the proposed change of program is acceptable.

(No objections were offered).

Secretary: I would like to present the name of Mr. George B. Cortelyou, Secretary of the Department of Commerce and Labor, to be made an honorary member of this Society.

Motion seconded and unanimously carried amid great applause.

The paper by Mr. S. P. Bartlett, of Quincy, Ill., on "Angling for Carp and Some Hints as to the Best Mode of Cooking," was then read by the Secretary and discussion had upon it.

Mr. T. W. Willard then read a paper by Mr. A. D. Mead of the Commission of Inland Fisheries of Rhode Island on the subject of "Recent Advances in Lobster Culture," and the paper was discussed.

Dr. James A. Henshall then read a paper on "Fish Food," which was discussed.

Mr. Charles G. Atkins then read a paper on "The Live-Food Problem," which was discussed.

At 4:30 p. m. recess was taken until 8 p. m. the same day.

EVENING SESSION, 8:00 O'CLOCK.

At 8 p. m., same day and place, July 21st, 1903, meeting called to order by the President.

Applicants admitted to membership.

The Secretary then read a letter from Mr. J. E. Gunckel, which is as follows:

Toledo, O., July 20th, 1903.

Hon. George F. Peabody, Secretary.
Woods Hole, Mass.

My Dear Sir:—

I very deeply regret my inability to attend the 32nd annual meeting of the American Fisheries Society.

Of all the associations that I belong to none seems to be nearer to me than this society. I have learned to like the members and their methods of cordiality. All I regret is that we haven't more truthful anglers among them. I have tried for many years to instill this important addition to a fisherman's life, to some of the members, but they absolutely refuse to follow example. I know you will have a splendid time and hope to meet you next year.

I enclose one dollar, annual dues for 1903-'04.

This is my busy time of the year with excursions, being a railroad man I can't go so far away from my territory.

Hope the members will not forget.

J. E. GUNCKEL.

Also letter from Mr. J. J. Stranahan, which is as follows:

Bullochville, Ga., July 28th, 1903.

Hon George F. Peabody, Secretary,
American Fisheries Society:

Dear Mr. Peabody:—

I have been so desperately busy that it has been impossible for me to work up a list of new members this year. Will double last one next year

I enclose check for $7.00 to pay for annual dues for

B. Andrews, Columbus, Ga., (think it is erroneously A. Andrews in last year's list).

E. M. Self, Bullochville, Ga.

Samuel Lovejoy, Bullochville, Ga.

J. J. Stranahan, Bullochville, Ga.

And membership fees for

J. E. Guard, Bullochville, Ga.

George H. Isaac, Washington, D. C.

C. C. Lewis, Washington, D. C.

I also enclose my paper on black bass. I have written Mr. John W. Titcomb asking him to read it for me.

My heart and soul is with you all in this meeting and I hope that it will be the best ever held by the society. The commissioner very kindly ordered me to go to the meeting if I could be spared, but it is just out of the question. Yours very truly,

J. J. STRANAHAN.

Also part of letter from Prof. Henry B. Ward:

Lincoln, Neb., July 16th, 1903.

Hon. George M. Bowers,
U. S. Fish Commission, Woods Hole, Mass.:

My Dear Commissioner Bowers:

I regret very much that personal matters will prevent my being

present at the meeting of the Fisheries Society, but have sent a paper, which I trust may be of some interest.

With regards, I remain very truly yours,

HENRY B. WARD.

The Program Committee then presented the following program:

PROGRAM.

MEETINGS OF AMERICAN FISHERIES SOCIETY.

WOODS HOLE, MASS., JULY, 1903.

July 21.

12 m.—Assembly Room, Fish Commission Building. Routine business.

2 p. m.—Steamer Fish Hawk. Reading and discussion of papers.

8 p. m.—Assembly Room, Fish Commission Building. Further reading of papers and discussion of same.

July 22.

9:30 a. m.—Assembly Room, Fish Commission Building. Reading and discussion of papers.

2:30 p. m.—Unveiling and dedication of memorial to Prof. Spencer F. Baird.

8:00 p. m.—Assembly Room, Fish Commission Building. Reading and discussion of papers.

July 23.

8:30 a. m.—Steamer Fish Hawk, which will leave Woods Hole for Providence, R. I., at 7:30 a. m. Report of standing and special committees.

Report accepted and adopted.

Mr. Titcomb: The Committee on Papers have to say that it was first suggested that we have the bass papers, but I hear that a good many feel fatigued, and the bass papers are still coming in, and it looked as if there would be a long discussion, and much time taken in reading them; it has, therefore, been suggested that several of the papers, which will not naturally take so much time in discussion, be read this evening. Among those may be

mentioned one by Mr. Waldo F. Hubbard on Transportation of Green Brook Trout and Salmon Eggs, relative to the comparison of the two species of eggs with reference to bearing transportation or rough usage; also a paper on the "Striped Bass" by Mr. Daniel B. Fearing of Newport; and in connection with that Mr. S. G. Worth of Edenton, N. C., will have something to say about the success of his work in hatching striped bass for the United States Fish Commission this last spring; also a paper by Mr. John P. Whish of Albany on "Some Facts showing the Commercial Value of Fish Culture in New York State;" and there are several other papers which will be ready in case those do not take up all the time.

Paper by Mr. Waldo F. Hubbard on "Transportation of Green Brook Trout and Salmon Eggs," relative to the capacity of the two species of eggs with reference to bearing transportation or rough usage, was then read and discussed.

Rev. E. M. Waterhouse of Providence, R. I., then read a paper by Mr. D. B. Fearing of Newport, entitled, "Some Early Notes on Striped Bass," which was discussed.

Adjourned to same place July 22nd, 1903, 9:30 a. m.

Wednesday, July 22, 1903.

United States Fish Commission Building, July 22nd, 1903, 9:30 a. m., meeting called to order by the President.

Report of the Secretary in conjunction with the Baird Memorial, presented.

Secretary: There is no regular report of the Baird Memorial Committee, excepting a letter and statement from Mr. Blackford. He encloses a list of subscribers to the Baird Memorial fund, a list of disbursements, and a check for $94.85, being the balance on hand. This is to be used for the expenses of the speakers, etc., at the unveiling. Mr. Blackford is so ill that he cannot be here.

The President then read a letter from Mr. H. M. Smith:

Sendai, Japan, June 17th, 1903.

My Dear Mr. Bowers:

In regard to the Baird memorial exercises to be held during the meeting of the Fisheries Society, I beg to advise you that I placed all the papers and plans in the hands of Mr. E. G. Blackford, the Treasurer. I did not hear from him before leaving Washington, but I suppose he has gone ahead with preparations, contemplating the attachment of the tablet and the covering of the stone with an American flag, address by Prof. Brooks, and perhaps by Mr. Blackford and Mr. Blatchford, and unveiling of the boulder by Vinal Edwards.

I hope the Fisheries Society, under your presidency, will have its most successful meeting, and wish I could be there to help in any possible way to that end.

I trust the new fiscal year will have opened auspiciously for you personally and officially.

Before this reaches you I expect to be on the long homeward journey, the end of which will be most gratifying.

With kindest regards to yourself and family, I am,

Yours sincerely, H. M. SMITH.

The Honorable George M. Bowers,
U. S. Fish Commissioner, and
President of the American Fisheries Society:

There are many people who will be at Woods Hole who never saw Prof. Baird. Permit me to suggest that his portrait in the Washington office (my room) be sent on and and hung in the residence.

Mr. Titcomb: The committee have to present first some specimens of oysters from Puget Sound, and these were sent to Mr. O'Mally, with a letter which he has authorized me to open, and Dr. Graham, who is interested in the oyster culture here, and who has been studying the question, has kindly consented to read it, after which if you will ask him questions instead of me, perhaps you will get more information.

Letter from Huntoon Oyster Company regarding samples of native seed oysters taken from Samish Bay, Dagget County, Washington, was read and discussed.

Mr. Titcomb: I move that the thanks of the Society be rendered to the Huntoon Oyster Company through the Secretary for submitting this exhibit, and suggest that if it is possible to obtain a photograph of that webbing with the spat upon it, inasmuch as it seems to be an entirely new method of value to other

oyster culturists, one be taken for publication in the report with the letter.

President: Do you think that should be done by the Fisheries Society?

Mr. Titcomb: Either the Commission or the Society.

Secretary: I think the Commission had better do it, furnish me the photograph and I will publish it.

President: That letter asks in a general way for information, and I think it would be more proper to have the Fish Commission do that than to have the expense placed upon the American Fisheries Society.

Resolution of thanks unanimously carried.

President: The next in order will be the report of the Committee on Nomination of Officers.

Mr. Bower: The Committee on Nomination of Officers for this Society for the ensuing year, after due consideration respectfully and unanimously recommend the following candidates:

For President—Frank N. Clark of Michigan.

For Vice President—Dr. Tarleton H. Bean of New York.

For Recording Secretary—George F. Peabody of Wisconsin.

For Corresponding Secretary—W. DeC. Ravenel of Washington.

For Treasurer—C. W. Willard of Rhode Island.

FOR EXECUTIVE COMMITTEE.

E. W. Blatchford, *Chairman,* Illinois.
C. C. Wood, Massachusetts.
R. D. Hume, San Francisco.
M. E. Merrill, Vermont.
J. E. Leary, Texas.
E. A. Tulian, Colorado.

Mr. Titcomb: I move that the report of the committee be accepted and adopted.

Motion seconded and unanimously carried.

Report of Committee on Selection of Time and Place called for.

Mr. Titcomb: The Committee will be glad to hear from any

who have suggestions as to places, and inasmuch as we are pretty busy today, it was intended to hold a committee meeting tomorrow on the Fish Hawk which will start at 7:30 a. m. promptly.

Mr. Henry T. Root, of Providence, R. I.: At the meeting at Put-in-Bay last year, after it was decided that this meeting be held at Woods Hole, the delegation from Rhode Island extended an invitation to the Society to partake of a clam bake in Rhode Island waters this year. That invitation was extended in good faith and was accepted at that time, and we expect that everybody that is here, and their friends, will go up there tomorrow on the Fish Hawk, and partake of our clam bake. We have been at the pains of sending up some 10 bushels of our own clams that the Rhode Island Commission has raised, to give you a taste of what we can do in the artificial propagation of clams. And we haven't any doubt at all but that you will have a good time. Crescent Park is a typical resort of Rhode Island, has all the paraphernalia of those shore resorts, and you can put in your time to good advantage. The United States Fish Commission has a very interesting exhibit there too, and we feel that you all ought to come, and we shall be disappointed if you do not. (Applause).

President: It is hardly necessary to put the motion to accept the invitation, as I am sure every one present will go and take his wife and children, if he has them, if it is expected.

Mr. Root: It is expected. You will remember last year that all said they would come and bring their wives, but I do not think that they have done it. If we had known that you were not going to bring your ladies we would have invited some for you. (Applause).

Mr. John B. Whish, Secretary of the Forest Fish and Game Commission of New York State, then read a paper on the subject of "Commercial Values. Some Notes on Studies of the Work of the Forest Fish and Game Commission of New York State," which was discussed.

A paper on the subject of "Fish on the Farm, What Species to Select," by Mr. Samuel Lovejoy, was read by Dr. Bean, and discussed.

The bass question was introduced by Mr. Titcomb, who read a paper by Mr. J. J. Stranahan, which was discussed.

A paper was then read on the subject of the "Propagation of Large-Mouth Bass at San Marcos Station," by John L. Leary, Superintendent, and the paper was discussed.

Adjourned until 2:30 p. m.

At 2:30 p. m., July 22d, 1903, the meeting was called to order by the President at the Boulder in the grounds of the Fish Commission at Woods Hole, and memorial exercises conducted, whereupon the meeting adjourned to meet at 8 p. m. at the office of the United States Fish Commission.

EVENING SESSION, 8:00 O'CLOCK.

Same day, 8 p. m., convention called to order at the office of the Fish Commission by the President.

The Secretary then read a letter from Mr. Henry B. Ward:

Lincoln, Neb., July 17th, 1903.

My Dear Sir:—

Up to the present date I had expected to be at Woods Hole for the meeting of the society, but some personal matters will make it impossible for me to leave here next week. I take the liberty of transmitting the title and will send you the manuscript in time to be read. The paper is entitled "Some Notes on Fish Food in the Lakes of the Sierras." I think that some observations made this spring will prove of considerable interest, in view of the fact that these lakes are without the usual supply of fish food, and yet have successfully maintained trout planted there during recent years.

Regretting my inability to be present, and extending best wishes to yourself and other members of the society, I remain,

Very truly yours, HENRY B. WARD.

Mr. George F. Peabody, Secretary American Fisheries Society, Woods Hole, Mass.

The discussion on bass was then resumed.

A motion was then made by Dr. F. N. Clark, seconded and unanimously carried that the President appoint a committee of three to determine the question of when young bass shall be called fry and when they shall be called fingerling, and frame a definition not only for the United States Fish Commission, but for all the state committees and private hatcheries, the commit-

tee, however, which shall be from the American Fisheries Society, not to be confined exclusively to the terms fry and fingerling, but to be authorized to select or invent any suitable term.

The President appointed as such committee Mr. F. N. Clark, Mr. Seymour Bower and Mr. W. DeC. Ravenel.

Mr. M. C. Marsh then read a paper on the subject of "A Fatality Among Fishes in Water Containing an Excess of Dissolved Air," which was discussed.

Mr. Titcomb: As there are only two more papers, Mr. President, I suggest that those be read tomorrow on the boat, and that we now adjourn.

Adjourned to meet on Steamer Fish Hawk next day, Thursday, July 23rd, 7:30 a. m.

Thursday, July 23, 1903.

On board Fish Hawk, July 23rd, 1903, 8 a. m., convention called to order by the President.

Applicants for membership duly elected.

The report of the committee on time and place was then called for.

Mr. Titcomb: The Committee on Time and Place met last evening to hear what any one had to offer for inducements as to the time and place of the next meeting. No one appeared to advocate any place in particular except Dr. Bean and Mr. Clark. Mr. Clark extended the invitation for the city of Buffalo which had been transmitted to him through circulars, as is customary with quite a number of these cities which entertain conventions. Mr. Peabody stated that he had received circulars from several other cities in the same way—Cleveland, Detroit and others. Dr. Bean advocated having the meeting during the exposition at St. Louis, his chief argument being that at that time there will be an international fisheries congress. The committee in taking into consideration Dr. Bean's suggestion, are unanimous in their opinion that during an exposition like the one in St. Louis, the Society would be lost during the meetings in the convention hall.

which would be tendered by the exposition people free. They could carry on their discussions if they would stay there, but it is feared that the members would want to be taking in the exposition. Other than during the actual hours of discussion the members would be scattered all over the city. There is no guarantee of any hotel accommodations—in fact there is practically a guaranty that we could not get them, and we would have to scatter around among the private houses. Now, the social intercourse which we get at these meetings is very valuable. We can hear Mr. Clark begin talking fish at 4 o'clock in the morning and we can hear him at 12 o'clock at night, after we go to bed, and we learn a good deal outside of the reading of papers. I think Dr. Bean's arguments, some of them, are very strong, but the committee believes that these meetings should be held at some point where they can be quiet, out in the country, for instance, or a place like this where there are some particular reasons for assembling, and if possible where they can have access to at least one fish cultural station, to investigate and discuss methods right at the point where the fish are propagated.

In the absence of any other invitation than that from the exposition people, the committee recommend that the matter of time and place of next meeting be left to the incoming President and the Secretary of the Society, to be decided later on.

Motion made and seconded that the report of the committee be accepted and adopted.

Mr. White moved that the matter be referred to the convention to determine as to the time and place of the next meeting.

(Declared out of order by the President).

Dr. Bean: I would like to have the privilege of saying a few words about the proposition to meet at the time of holding the exposition in St. Louis. The invitations which are extended by the President of the Exposition Company, and the mayor, as well as the President of the Board of Trade, give assurance that this Society will be entertained in a hospitable manner, and that there will be no difficulty about accommodations. Those of you who know D. R. Francis will certainly know that he is a man who keeps his word; on that score there need be no reluctance on the part of any member of this Society in going to St. Louis.

I have lived there myself 19 months and I know it is easy to find accommodations within reach of the exposition grounds. Of course the hotel accommodations are scanty, I admit that. I do not live at a hotel now, and one need not confine himself to hotel accommodations in St. Louis. During the dedication ceremonies 100,000 people could have been accommodated in private houses who did not avail themselves of the opportunity and went away disgruntled because they could not get into the hotels. I do not blame the people for not over-building. Chicago and Buffalo had their fingers burned by over-speculation in that direction. St. Louis is conservative, its financial standing is of the highest, and there is no reason why they should build beyond what the natural growth of the city will sustain.

Now, I want to say another word in another direction. The United States Fish Commission is going to have at St. Louis the finest display of fishery and fish culture that it has ever prepared or that the world has ever seen. That is one feature that we will have at St. Louis, and only at St. Louis. We will certainly not have it at Buffalo. The nations of the world are coming to St. Louis and they are coming there bent on acquiring information about the fisheries and fish culture of the United States. Representative men will be there from all over the world. Now, gentlemen, how will it appear if the force and the life of fish culture in the United States, represented by the United States Fish Commission and the American Fisheries Society, should be omitted from that program to which we have invited our foreign representatives? It would be a shame and a disappointment, and I do not believe this society would feel that it had done itself justice. The American Fisheries Society represents today the activity of fish culture interests in our country. The people who are coming are the best that Europe, India, Ceylon, Australia, China and Japan, can produce. France and Germany will be there, also Great Britain, Norway and Sweden. Now, why should the United States be left out as far as its representation by the American Fisheries Society in connection with the United States Fish Commission is concerned? That is about all there is of fish culture. I do not mean, of course, to omit the states, not by any means, but the states, too, will be there, 20 or more of them will be represented in that little building over

which I have the pleasure of presiding, and still more of them in other buildings. Now, would it do, do you think it would be altogether creditable to us—we have labored long and earnestly to advance the cause of fish culture—to stop right now and hide our light under a bushel and let the foreigners go away believing that the state of Missouri, for instance, is all that there is of fish culture? You will have there the fish culture station within Forest Park which can be visited; the state of Missouri has a fish car which I have not the slightest doubt will be placed at your service if you wish to go to the Ozark to see how the rainbow trout is thriving, and you can study other fishes to your heart's content. Furthermore, you will gain more members in St. Louis than in any other city of equal size, and I hope this subject will be very fully considered before it is left in uncertainty. (Applause). With due respect to this committee, we have a large gathering of members, larger than we have ever seen at our meetings before, and if it would be in order I would propose that this gathering here vote upon the place where we are to go, and I make that as a motion.

Motion seconded.

President: There is a motion before the house, the adoption of the report of the committee.

Mr. Titcomb: As chairman of the committee perhaps I ought to explain still further the consideration given to Dr. Bean's argument. It is true that there will be an international fisheries congress, and we understand that there will be representatives from all over the world of the fishery interests, and the states will undoubtedly have delegations to attend this international fisheries congress. The United States Fish Commission ordinarily sends representatives also to the International Fisheries Congress; in Paris it had two representatives.

Now, the Fisheries Society would meet, of course, as a society. This society would not run the International Fisheries Congress. It is the privilege of every member of this Society to attend that congress, and of course if the meetings were held there and held on separate days so that it would be possible to do so, the members would have a chance to talk fish a week instead of three days. But I cannot see just how the Society as a society

can hold its convention in connection with the International Fisheries Congress on the same date and in the same meeting without losing its identity.

President: Have the time and place of holding the National Fisheries Congress been fixed?

Mr. Titcomb: I understand not.

Dr. Bean: I believe not.

Mr. Titcomb: Then how can we determine the date of our meeting.

Dr. Bean: The exposition has furnished one of its finest buildings, the new library building of the University, which is divided up into session rooms, capable of holding all the congresses that may be there in any one day, and there is no reason on earth why the Fisheries Society should be lost—in fact, it could not be lost—it could not lose itself if it tried. Imagine the Fisheries Society lost. We have heard of a lost salmon or a lost carp, but never of a lost fisheries society, and I hope we never will. (Applause).

Mr. Atkins: Allow me to say that it seems to me decidedly better that we should not undertake at this meeting to determine when or where we shall hold our next meeting. I think the proposition of the committee to leave that to be determined by the officers later, is a very wise one, and that we had better not undertake here to fix the matter, because I at least on my part do not feel sufficiently informed in relation to it as to what the facilities will be at St. Louis and other places.

Dr. Bean: I understand that the incoming president has a choice.

Mr. Clark: No, I want to correct that, not that I care to have this left to the committee, but I wish to correct the doctor right here. I have no choice, and so stated last evening before the committee, and I think the doctor will bear me out, that personally I have no choice, I was simply doing that which I thought was my duty as a courtesy to a city that is entertaining many conventions, the same as my own city of Detroit. The secretary of the convention association of Buffalo, composed of the city officials of Buffalo and many others (very fine gentlemen), corresponded with me and urged that I take the matter up. I had a great deal of correspondence with them and tried

my best to have a member of that committee here, and after all the correspondence and considering to a certain extent my position in the American Fisheries Society as being one of the old members, I felt it was due to that city and committee that I should present the name, but I took special pains last evening to say it was not my personal choice. Am I not right?

Dr. Bean: Yes.

Mr. Titcomb: For the committee I wish to say that they have some of the same reasons for recommending that we do not meet at Buffalo which they have for recommending that we do not meet in St. Louis. Buffalo would be a more comfortable city in July than St. Louis. St. Louis will be very hot, probably, but the committee believe that this Society should meet in some quiet place, where there are no distractions whatever, where we can have our meetings by ourselves and enjoy the country air and all that sort of thing, and if possible get at some fish cultural station, or go to some point centrally located where it will be possible for us to take in the St. Louis exposition on the way.

Mr. Clark: Just one word more, if you will permit. The members may think I want this thing left to the officers, but I do not. The only reason I have not positively refused to allow it to go that way is, that so long as I have been an active member in the Fisheries Society, some twenty-seven or twenty-eight years, I do not think I can call to mind a time when the recommendations of the committee on time and place or officers were turned down.

Mr. Atkins: I move that the committee be instructed to investigate this matter further and to report to the officers of the Society at a later date in relation to the subject of the time and place of the next meeting.

Dr. Bean: I would like an expression of opinion from the members of this Society. I think we should accept or reject the invitation of St. Louis. I have been sent here for the express purpose of inviting the Society to meet at the exposition, and they have given every assurance that the Society will be welcomed and well cared for, and I think that it is due to the exposition that we have an expression of opinion of the membership present, and I would like to have it very much.

Secretary: I would like to say a word regarding the invita-

tion from the exposition and the mayor of the city, etc. Dr. Bean is undoubtedly sincere and earnest, we all know that, and these men who give this invitation are undoubtedly for the moment sincere and earnest, but they are going to be swallowed up in thousands of invitations and of much larger societies than this, and when we get there we simply would not be noticed. Now, in Milwaukee—General Bryant will bear me out in that—we had the mayor of the city, commercial societies and others send us invitations and saying that they would make it pleasant for us, yet we hardly saw anybody in Milwaukee—not that it is necessary that we should be entertained, but yet it is something to be in a place not so large but that we will be recognized in a way.

Now, as to the accommodations at St. Louis in July. If we are going to St. Louis we certainly should not go there in July, because it is a very hot place, and not only that, but the city will be thronged with people, and Mr. Titcomb's point I think is very well taken, that we ought to be in a place where we can meet together after the meetings to interchange thoughts and social amenities, which we cannot do in a large city. We will have to be scattered around at private houses and all that sort of thing, and only meet at our regular sessions, and I fear very much that the attractions for some of our friends here will be so great that we may not be able to discover them at the meetings—I do not know but what I would get lost myself in that case. (Laughter). Now, it seems to me that we ought to consider some quiet place. I have had invitations as secretary from Cleveland, Detroit, Niagara Falls and half a dozen of those places, which I have not presented to the convention, because they are conventional invitations and these are convention cities, and it is a professional thing for them to attempt to get conventions there to help out their hotels and one thing and another, and for that reason, while I do not wish to have anything to do in deciding this question, I do think it ought to be very carefully investigated, and it seems to me the success of our meetings depends very largely upon the location and the time, and we have, after very careful investigation decided upon this time of year for meeting. It seems to be an opportune time. Now, men who are interested in schools and colleges, professors of biology, etc., such

as General Bryant, for example, have this time of year as their vacation period when they can come here, and I think it meets the convenience of more men than any other season of the year. I, therefore, think St. Louis should hardly be considered on that account, and yet if it is the voice of the convention we will do all we can to make the meeting a success.

General Bryant: I feel like supporting the motion, leaving this to the officers to settle. It seems to be very generally understood that it would not be comfortable for us to go to St. Louis in July. I spent a summer in St. Louis many years ago, and I think you can find grease spots on the pavements yet where I larded the lean earth (Laughter), and if you put it off until September I cannot go. I have to go on the jail limits in Madison at that time, for I am a professor at the University. I want to come to these meetings. It has got to be part of my living to attend the meetings of this Society. If you have them at St. Louis I must be left out. Then, too, if you go to St. Louis you would have to put a ball and chain on Brother Lydell to keep him anywhere within reach. (Applause and laughter). I appreciate Dr. Bean's position entirely and I sympathize with him, and I think I could risk a day or two at the International Congress, but if I go there I want to go there as a delegate, representative, or humble member to sit in that congress, not with a divided duty, a split affection, and I do feel that we enjoy ourselves better, we get into closer touch, than we would with all our young lads running off for a Midway Plaisance (Laughter); and that is my feeling about it, partly selfish and partly for the interests of the Society. Now, if developments are such that our officers shall think at a later day that that is a proper thing to do, why, we will all acquiesce in it. If they select some other locality I have no doubt they will select one that will be very congenial to us all, and for my single and humble self I should prefer to leave it in that way. I hate awfully to disappoint Dr. Bean, but I am afraid if we get down there in that great multitude we would feel like a small boy at a circus.

Dr. Bean: It is not a question of disappointing Dr. Bean or Doctor anybody, it is a question whether the American Fisheries Society is big enough and strong enough to take its place as a man in fishery matters. The other people are coming there, are

we going to stay away? Now, I really would like to have an expression of opinion from the members here, and I wish that Mr. White's motion would be entertained.

President: In the absence of a substitute being offered, there is only one question to be considered, whether or not the report shall be accepted or rejected, and the question is on the committee's report.

The motion to adopt the committee's report was then unanimously carried.

Dr. Bean: This is to be left with two officers, the President and Secretary?

President: Yes, and St. Louis may stand a pretty good chance yet.

Dr. Bean: If a vice-president were included possibly the leaven would work. (Laughter).

Mr. Clark: With the consent of the committee and the members of this association I would like to make a motion that the Vice-President, Dr. Bean, be added to that committee.

Motion seconded and unanimously carried.

Mr. Clark: I want to say that I feel if I am not broad enough, our secretary and Dr. Bean are able to take up this question and settle it for the best interests of the society, even if Dr. Bean is strongly committed to St. Louis, I feel that between us we can convince Dr. Bean to the contrary, if it is thought best to go to some other point, and I know that he is broad enough to accept the situation.

President: Doctor, you are in it. (Great laughter and applause).

The auditing committee then presented its report, that the committee had examined the report of the treasurer and found the same to be correct.

Report accepted and adopted.

Mr. W. T. Thompson then read a paper on "The Golden Trout," which was discussed.

The President then read a paper by Mr. Henry D. Ward on the subject of "Some Notes on Fish Food in the Lakes of the Sierras."

Mr. Clark: I would like to express my appreciation to the members of the American Fisheries Society in honoring me by an election to the presidency, and I want to say, gentlemen, that I feel highly honored, I only fear that I have not the ability to preside in an acceptable manner so that I may come near the degree of success of my predecessors. I do not wish to take this honor thinking that the members of the American Fisheries Society have honored me alone. It is not so. They have shown their appreciation by honoring the practical superintendents of the United States—that is what they have done. It is not Frank Clark alone, but it is the superintendents of the United States.

Now, members of the American Fisheries Society, I may not have an opportunity of shaking hands with all of you before I leave you, but I want to say again in thanking you for this honor for myself and the practical fish culturists throughout the United States, superintendents and others, I want to say to you one and all, good-bye till we meet again next year at ————————. (Laughter and applause).

President: I wish personally to congratulate you on the success of your meeting. I am sure that good results attained here will inure to the benefit of the fisheries of the United States, and you deserve the good will and the congratulations of every man interested in fisheries. (Applause).

Secretary: I desire to offer the following resolution:

Resolved, That the Society extends its hearty thanks to the United States Fish Commission, to Mr. Locke of the Woods Hole station, and to all others who have assisted in entertaining the Society at its present meeting, for their many courtesies and thoughtful attention, which have done so much toward making this meeting one of the most delightful in the history of the Society.

Motion seconded and unanimously carried.

Mr. Clark: I move that the thanks of this Society be extended to the officers for the last year, for their good hard work in providing for this Society, and for the presiding and other work that they have done at this meeting.

Mr. Blatchford put the motion.

Mr. Blatchford: All those in favor of that motion thanking

these faithful and honest men (I think they are honest, the Auditing Committee says so), will say aye.

Unanimously carried.

Mr. Blatchford: If there is any chap questions it let him say, nay. (Applause and laughter).

Adjourned.

AFTERNOON SESSION, 2:00 O'CLOCK.

At 2 p. m. the steamer reached Crescent Park, near Providence, where the Rhode Island Fish Commission spread a magnificent clam bake banquet in honor of the society. The governor of Rhode Island, his staff and many prominent officials of the state and citizens of Providence were present, and the society was welcomed by the governor, who said:

In behalf of the state of Rhode Island I welcome the American Fisheries Society of the United States.

At the conclusion of the banquet Mr. Root said:

It is a well known fact to you all that the United States stands at the head of the fisheries of the world. Now, I wish to impress upon you that a condition of that kind must require great executive ability, organization and energy, that can be found in scarcely any other occupation, and I further wish to state that we have with us today the most noted men in the fisheries industry of the world. (Applause). Now, we have such men here as you have all read about, such as Livingston Stone; we have all read about Dr. Henshall and his bass rods and reels; we all know Dr. Atkins and Dr. Bean, the great expert on fish anatomy. Now, to handle all this thing and get the position that the United States has got, as I said before, requires great executive ability, and a head must be wonderful that can handle all this. We have today here twenty-one superintendents of the hatcheries of the United States. I venture to say such a number never got together before. Now, what I got up here to say was simply to introduce to you the head of this great organization the Hon. George M. Bowers, of Washington, D. C., Commissioner of Fisheries of the United States. (Great applause).

Mr. Bowers: Governor Garvin, Ladies and Gentlemen. Owing to the lateness of the hour and the fact that quite a num-

ber of the members of my party are expected to return to Woods Hole between the hours of half past four and five, I shall not make any extended remarks. I congratulate you, Governor, on the efficient, able representatives you have composing the membership of the Rhode Island State Commission. I congratulate the state of Rhode Island upon the prominent position it has attained in fisheries, and I have before in conjunction with the members of the American Fisheries Society, accepted the hospitality of your people, which we all appreciate, and I hope the day is not far distant when one of our meetings may be held in your state. (Applause).

Mr. Root: I wish to further state that the American Fisheries Society is thoroughly a United States organization, and has got to have a head also. Commissioner Bowers is above all of them, but we have a president of the American Fisheries Society, a man that when he gets talking about fish will talk from 4 o'clock in the morning till 11 o'clock at night—he cannot talk on any other subject, but I want him to stand up so that you can see him—Mr. Frank M. Clark of the Michigan State Association. (Great applause).

Mr. Clark: I think I voice the sentiment of the American Fisheries Society when your Governor of Rhode Island welcomes them to this clam bake, in saying that they heartily thank you for this entertainment. The American Fisheries Society extends over the whole United States, and this little state of Rhode Island is entertaining us in this generous manner. I have attended the American Fisheries Society meetings for many years, and I have attended two entertainments given by the Rhode Island people, and I assure you that I voice the sentiment of the American Fisheries Society when I say that we have never in this broad United States received such entertainment as we have received in the state of Rhode Island. (Applause). I wish to say, Mr. Toastmaster, that the American Fisheries Society and all of its members again thank you for this very generous entertainment. (Applause).

Mr. Root: Right here I wish to say that I think the state of Rhode Island never profited more by any delegation that visited its shore and partook of its clam bakes than it has from the peo-

ple we have here representing the American Fisheries Society. I believe that if you could attend one of their meetings and hear their discussions of papers, you would agree with me heartily, and we consider it a great honor, Mr. President, of the American Fisheries Society, that you have accepted our invitation to come here.

Secretary: In behalf of the American Fisheries Society I wish to offer the folowing resolution:

Resolved, That the Society offer its grateful acknowledge for the courtesies extended by the state of Rhode Island Fish Commission, for its generous hospitality that rounds up in a most appetizing way one of the most, if not the most, successful meeting ever held by the American Fisheries Society.

Motion seconded.

Secretary: Before that resolution is put I would like to say: One year ago Mr. Root, President of the Rhode Island Commission, told me a fish story at our meeting at Put-In-Bay. He said that one morning at a lake near by where he has a summer home and lives, he caught sixty-eight bass that weighed 13 pounds apiece, all wall-eyed black bass. I do not know that this is accurate, because we have just enjoyed a large dinner, but it is as near as I can get to it. Now, I repeated this story to a friend in Chicago, and he said, "A lake in Rhode Island—there are no lakes in Rhode Island—it is not big enough for a lake." I wish I had that gentleman here now. He would think Rhode Island was as big as the state of Texas. (Great laughter and applause).

General Bryant: I rise to support this resolution. A political friend of mine once said when he had felt the ingratitude of men he had helped and favored in politics, and I was trying to console him, with a rueful shake of his head, "Hungry men are never grateful for last year's dinners." (Laughter). I want to say that that is not the principle nor the characteristic of the American Fisheries Society. We came here three years ago at the invitation of your good people, and we had one of your clam bakes, a feast so unique, so excellent, so noble, that it has lingered in our memories for three years, and there is not a member of this society that has not turned his thoughts towards Rhode Island, with a grateful emotion, ever since, (great ap-

plause) and today that has been repeated, with added charms, with added excellence, and upon us is heaped an added weight of gratitude which will be carried all our years.

There is something about these Rhode Island clams that is very remarkable, and it has opened my mind and let into it a great flood of light. After we had dined here three years ago and partaken of this nourishing food, there was not a member of our society that did not feel such an expansion of his mental power and his self-confidence, that he looked upon himself as capable of being the governor of a state, member of congress and chairman of a leading committee, or even a senator in the senate of the United States (great applause and laughter) and after having taken a second feast in this beautiful spot, I am free to say that I feel perfectly competent now to be President of the United States (great applause), and if you would only give me a congress agreeable to my way of thinking I give bond that I would revise the tariff, smash the trusts, regulate labor and capital, and put them on a harmonious basis and save the government in the expense of administration two hundred and fifty million of dollars, and at the same time we would double the appropriation of the Fish Commission (great applause and laughter), and give a special bonus to every state fish commission in the United States. (Great laughter). All of that we could do if you fed us on clams. (Great laughter and applause). We lawyers read in the lighter literature of our profession, that a man could get admitted to the bar in England if he entered the inns of court and ate so many dinners at the hostelry of the inn—I think about two dinners here would be equal to a good college education. (Great laughter and applause).

But pleasantry aside, your Excellency and Gentlemen of the Rhode Island Fish Commission, again in the name of the American Fisheries Society I want to extend to you our heartiest thanks for this magnificent banquet you have given us, on this beautiful spot, so lovely that we are loath to leave it, and to leave you, and as we go away I want to voice the prayer of this society, in praying that the good fish commission of the state of Rhode Island may long be detained from that mansion of rest provided for the American Fisheries Society in the realms of glory. (Great laughter and applause). I hope they may long be de-

tained from it to be benefactors of mankind in this beautiful state.

And I have another prayer to the executives of this state, who may come and go—politics change—I want them to keep those magnificent old spirits, Commissioner Root, Commissioner Willard, Commissioner Boardman and the others I will not name, in the posts of duty where they are accomplishing so much good. (Applause).

Now, gentlemen, the American Fisheries Society are a very good people. Modesty forbids us telling how good we are, but honesty compels us to admit it. (Laughter). This world is made up of very bad people, bad people, good people, very good people, extraordinarily good people and the American Fisheries Society. (Great laughter and applause). Now, that may seem a hard saying, it may seem boastful, but I call on you to remember that when our blessed Savior came on earth, one of the miracles that he performed to testify his great power, the omnipotence delegated to him, was to multiply the fishes in the sea. That miracle, I say reverentially, Your Excellency, through the aids of science, through the work of these noble men who constitute the working force of this great society, we are accomplishing today. There is hardly a river in our myriads of streams, there is not a coast on our illimitable line, that is not blessed and multiplied by the work of the United States Fish Commission, the State Commissions, the American Fisheries Society throwing in its moral force, its investigation, its uniting of all the men engaged in this great work. They are not working for fame, nor for fortune. They are working for the public good, and years hence along this shore of your beautiful bay, men will rise up to call blessed the commissioners of fisheries who during their brief span of life have labored faithfully without fee, without salary, without compensation other than that chiefest of all compensations, the consciousness of a good duty well performed. (Applause).

And, gentlemen, again one and all, you people of Rhode Island, we shall carry to our distant homes the pleasantest remembrance of your kind welcome and the charming feast you spread for us today when we came among you with appetites saved up to enjoy it. Good-bye! (Great applause).

President Clark: You have heard the resolution as offered and supported by General Bryant in such an excellent manner.

The motion was then put and unanimously carried.

Secretary Peabody: I have another resolution to offer:

Resolved, That the American Fisheries Society gratefully acknowledge the efforts of the Commissioner, Hon. George M. Bowers, in making the meeting of this society a success, and also acknowledge the courtesy and efforts in making the trip from Woods Hole to this point a delightful one on the part of the officers of the United States Fish Commission steamer Fish Hawk.

Mr. Blatchford: I rise without taking any time to make any remarks which I would like to do, very heartily to second that resolution. (Applause).

Unanimously carried.

Adjourned sine die.

Deceased Members since last meeting:

Dr. E. Bradley.

Gen. E. E. Bryant.

Dr. Busbrod W. James.

S. L. Griffith.

PART II.

SCIENTIFIC PROCEEDINGS.

ANGLING FOR CARP, AND SOME HINTS AS TO BEST MODE OF COOKING.

BY S. P. BARTLETT.

In compliance with a request of the Corresponding Secretary, I have the honor of offering a few suggestions as to the catching of carp with hook and line, and some of the popular ways for preparing them for the table.

The question has been asked me a great many times why it was that carp cannot be taken with the hook and line. A great many persons have told me that they have used all kinds of bait and failed to get them to take it. These inquiries came to me as a surprise from the fact that hundreds daily fish for carp with hook and line on Quincy Bay and all along the Illinois river with great success.

I have found the best bait to be a dough ball made by boiling cornmeal to a good stiff mush, and then work the ordinary cotton batting into it until it becomes hard and stiff, and then rolling into little round pellets about the size of a marble. Bait prepared in this way will not be easily dissolved by the water. I use the ordinary Carlisle hook fastened on the end of a good strong line and three or four inches above the hook, attach quite a heavy sinker which will take the line to the bottom and allow the bait to flow up away from the bottom. Another good bait is the ordianry ship stuff from the mills, boiled stiff and dough rolled out in sheets, and then cut up into little spuares, perhaps three-fourths of an inch square. Fried potatoes, sliced raw and fried until they become stiff, not brittle, also is a fine bait. Anyone conversant with the hook and line at all, will have no trouble in catching carp if this bait is used as indicated.

On Quincy Bay, I have seen as many as two hundred people fishing for carp along the shores, and nearly all of them get good fair strings. The carp when hooked is a very vigorous fighter, and care must be used that he does not break the hook or break out the hook from his mouth. I would advise the use of the landing net. They are daily taken on trout lines, using the same kind of bait.

Since your request for information as to the carp from an angling standpoint, I have given the matter a great deal of attention, and have been greatly surprised at the extent to which carp are caught with hook and line. From Cairo to Dubuque on the Mississippi river I have found shores at all the towns lined with people fishing for carp, all catching them. One day last week, from the lower end of Peoria, Illinois river, to water works point, a distance of three miles, I counted 1,103 people fishing with hook and line, and on investigation developed that a large per cent of them were taking carp. The majority of those caught weighing a pound and as heavy as five pounds, all of them probably used as food.

Permit me to introduce here a letter from one of the best known sportsmen in the state:

Peoria, Ill., June 23, 1903.

Hon. S. P. Bartlett, Esq.,
Superintendent Fish Commission, Quincy, Ill.

Dear Sir:—

Carp fishing with hook and line has now taken its place with bass and other kinds of fishing. All along the river in this locality carp are being caught freely with hook and line this year, and to say they are gamey, is not half expressing it. For the past month, I have made it my business to go along the river and take notes of this particular kind of fishing and talked with no less than 25 different persons who were busy catching carp, and in every instance I was told it was rare sport to hook a carp, as it was quite as much of a trick to land one as it was to land a bass; dip nets were used generally to land the carp, as the activity of the fish when jerked out of the water would tear the gills and free the fish quite often. The bait used when fishing for carp is dough balls and partly boiled potatoes, the latter being best in the opinion of the majority. The carp will bite on worms quite freely also, and in two instances, I found carp had been taken with minnows, something that has been considered impossible heretofore, but in these two cases I am certain it was done, as I have the names of the parties who caught the fish. An old German who lives here goes daily to the river with a regular fly casting pole and reel to fish for carp, of course, he exchanges the fly for the regulation hook, but he used his reel in landing the carp, and says there is no finer sport than fishing for carp. This man uses partly boiled potatoes altogether and is very succesful in taking carp in numbers daily. I have caught a great many carp myself with hook and line, using potatoes, dough balls and worms, and found that the partly boiled potatoes worked best, as the carp seemed to take that particular bait when they would not bite on

any other. As for the sport of catching carp with hook and line, I consider it equal to anything in the way of pleasure fishing, as the fish is gamey and will fight as hard against being landed as bass or other game fish and are to be handled with precaution on account of their tender gills, which will often tear when hooked by an inexperienced angler. In the past two years carp have become popular where they were unpopular, because of the wearing away of the prejudice that they were of no benefit to the angler on account of the belief that they would not take a hook. Now it is different, as the very ones who were so loud in their protest against the carp, have found great sport in taking them with hook and line, and it is wonderful to hear the change of sentiment as to the carp for food purposes. They are a good fish now and fit for a king in comparison to what was said of them while the prejudice still existed. To my mind the carp is a good fish for food purposes and is fast finding favor in the west in every way, now that the angler has found it is the coming fish for sport. Just at present in the Illinois river, we have a world of all kinds of game fish and no end of carp, which insures the angler his full measure of sport until the end of time.

Most respectfully yours,

M. D. HURLEY, Peoria, Ill.

NOW HOW TO COOK THEM.

I feel sure that most of the prejudice to the carp as a table fish is from the fact that they are too often taken from the warm water, fried and broiled without preparation. Their rapid growth and the warm water they are taken from, has a tendency to make them soft. I have found the best mode of preparing them as follows: Kill as soon as caught, by bleeding, taking out all of the blood. Skin, soak in salt water for several hours, then parboil and bake, basting frequently. They are frequently served here as a boiled fish, covered with proper dressing. It takes but a slight stretch of the imagination to place on bill of fare as anything from blue fish to buffalo. Today I had blue fish served with my soup at one of the principal hotels and it would have passed as such with the average man, tell-tale bones, however, said carp.

I give herewith a receipt of Swedish origin, given me by Dr. Weiss of Ottawa, Ill., President of the Fox River Fish and Game Association, who assures me that the perfected product is equal to the imported fish jelly that brings $1.00 per pound.

CARP OMELET OR CARP JELLY. (Swedish).

"Take a six to eight pound carp; scale and skin. Leave head and skin. Cut into small pieces and place in boiling water just sufficient to cover and add salt, coarsely ground pepper, allspice and a bay leaf or two. Boil about twenty minutes or until perfectly soft. Remove from the fire, remove pieces of fish from the water, but preserve the water. Break the pieces so as to be able to remove all of the bones thoroughly. Skin fins and head pieces. Strain liquid through a colander and if necessary add a cupful of gelatine, previously dissolved, to this liquid. At the same time add such other spices as may be desired. Add the original pieces of fish to the liquid or gelatinized liquid. Stir and place on ice until solidified."

I was greatly surprised at a statement made by Mr. Cohen, president of the Illinois State Fish Commission, to the effect that he had seen carp on menu of Waldorf Astoria hotel, New York, and at a price per portion higher than fresh mackerel. I was inclined to think he was telling me a fish story. In order to verify, he wrote chef of that hotel and received a letter and copy of bill of fare, which absolutely confirmed his statement.

In concluding this brief paper, I wish to say in explanation that in some way I have been considered special champion of the carp, and as such have been frequently misquoted.

I do not wish to be understood as saying that the carp compare favorably with our whitefish, bass or other game fish, salt or fresh. I want simply to repeat former statement, i. e., that the carp have in our western waters, filled a need, that nothing else would or could do. They have taken the place of the buffalo, now so rapidly decreased, and that they furnish good wholesome food to thousands who could not afford to use the more expensive fish, and who in a great measure depend on cheap fish for meat, that they have and are paying thousands of dollars to thousands of men in taking them for market, that they furnish equal sport for the angler with game fish, and as a combination are yet to have a place with other fishes, no one can doubt, and coming, come to stay.

DISCUSSION OF MR. BARTLETT'S PAPER.

Secretary: I want to say before reading this paper that the papers and discussions on carp of this Society have excited widespread interest, and as Secretary I have received innumerable letters on the subject, some damning carp not with faint praise, but most eloquently, and a few that favor the cultivation of carp.

Mr. Titcomb: A good many.

Secretary: Yes.

Mr. Clark: I have no doubt the members would like to hear from Mr. Ravenel on the carp question.

Mr. W. De C. Ravenel of the United States Fish Commission, D. C.: I have nothing to say. I endorse the paper.

Secretary: I would like to hear Mr. E. W. Blatchford's opinion regarding carp—he has eaten them.

Mr. Blatchford, of Chicago: Mr. President: I think it is twenty-eight years this summer since my first trip abroad; and I took a leisurely trip on the Rhine and was served with a fish for breakfast, I could not make out what it was. The waiter was a German, and he gave me the German name for this fish. My daughter, who was with me, spoke German fluently, and recognized the fish as a carp. I was much interested in it. I had heard about the carp, had read about it, but had never seen one until then. I asked our landlord if he would get me some; I wanted to see them; and he said, yes, that he would show me some that afternoon, and I went down and saw them swimming about in an enclosure. He said he had three ways of cooking them, and one of them was very much like the description given by my friend Bartlett, of Quincy; but they were a delicious fish, and I came home and began to speak about carp; but I have met few men or women here that did not turn up their noses at a carp. But the carp have been developed by being placed in waters adapted to them. I believe you can find plenty of streams in this state, and New York, and in the west, that would not be fitted for carp; but I have lived in Quincy, my parents lived there, and I know something about the interest that is taken in fish there on the Mississippi river; and have heard of them in Illinois, but I have never heard such an excellent statement as

that made by the gentleman from Peoria today. I am very glad of it. I do not know of any man that I sympathized with more, than with our honored secretary in the paper that he presented. I do not know whether he sent me a copy of the paper which I received—perhaps he is too modest to do it. He wrote a letter to a Wisconsin paper, a column and a quarter long, and put the carp right where it ought to be placed. I am not prepared to make any extended remarks, but want to say just one more thing: I enjoy these meetings and I regret that I could not be at the meeting in Put-in-Bay or Milwaukee, because both those years I was in England; but the last meeting I was at was held here—and why are these meetings interesting to me, and why ought they to be interesting to a great many more people than attend them? (And it is our duty to let their value be known and get them to attend them). The reason is this: We are working for a thing that has a clear and distinct element of utility *to our whole country.* Now just take the facts presented here by Mr. Peabody today, the number of people that are employed in this business, and the excellent food which they are securing by it: I think that is a very valuable paper that Mr. Bartlett has written. I do not know whether you all know him or not. He is our state commissioner of fisheries in Illinois, and he is a thorough student of whatever he takes hold of, and I do not know of anyone whose words are more valuable than Mr. Bartlett's. Is not that your experience with him Mr. Secretary?

Secretary: Yes, sir.

Mr. Blatchford: I feel that we should be thankful to have such a paper as that brought before us. (Applause).

Mr. John D. Whish, of Albany: Speaking of the experience we have had with carp in New York state, I should say we were getting considerable information right here. In our state the fish is regarded as a pig. The line fishermen do not like him. and the net fishermen curse his existence. We are today conducting experiments in various parts of the state, to find out whether it is true or not that the carp in New York state destroy game fish. The fishermen say that he does, and we have any number of letters on file in the office of the Commission, complaining about it; there is not a day that passes but we get an application for permission to net him out of some water; but

that is an impossibility, because he is like the English sparrow, here to stay. The fact however remains that our people are prejudiced against the carp as a fish and want to get rid of him. The county authorities of Erie county, two months ago, applied for permission to net the carp out of the Niagara river. Of course, anybody who knows anything about that river, knows he could not be netted out of there in a million years, if he was in there at all. But they got the permission and took out carp by the wagon load. The fish were disposed of to Italians and Poles at a low rate; and they seem to be the only nationalities who can cook the carp fit to eat. We are beginning to go a little slow with these permits to net out carp however, for the reason that the sentiment is veering around somewhat in its favor—that much I am willing to admit; but further than that, it is doubtful to my mind whether we will ever have a very great carp market in the Empire state.

Secretary: I would like to ask if the gentleman knows what the market price is or has been during the past year in New York city, at wholesale?

Mr. Whish: I do not know.

Secretary: I read the quotations every week in the Fishing Gazette. During the cold months it varied from 9 to 10 cents a pound at wholesale, and compared well in value with other first class fish.

Mr. Whish: The complaints we received are from the inland counties.

Mr. R. Tyson White: Many fishermen along the lower part of Long Island and South Bay are making a living from carp, selling them as fast as they catch them.

Mr. Clark: I do not wish to say very much on the carp question, but the question of carp interfering with anglers and the destruction of bass has been pretty thoroughly exploded by some member of the United States Fish Commission Scientific corps —I do not know who it was, that made some investigations in Lake St. Clair; and I think if the people will take pains to read what has been said in regard to that, they will find his conclusions were that carp did not interfere with bass or perch. I do not think the carp interferes in any manner with the eggs of these fish. The only complaint that I hear from up around the

Great Lakes, is from the duck hunters. They claim that the carp are destroying the rice roots, and possibly you may find that difficulty.

Secretary: It is so claimed.

Mr. Clark: I think the carp has come to stay in the Great Lakes as a commercial fish, and I do not think they are hurting the other fishes at all. We know in Michigan they are catching them in Monroe and Maumee Bay, by the tons, and in the month of June, while they were catching them, the Fishing Gazette quoted them at 4 and 5 cents a pound wholesale.

Mr. J. L. Leary, San Marcos, Texas: As to his destroying the eggs or young fish, it is not a fact. My experience is that I could not raise the crappy in clear water, and I adopted the plan of putting so many carp in crappy ponds, and I raised some crappy and no carp, showing that the young carp are all destroyed by the crappy. The smallest sun fish can chase him away, for the carp is a big coward; the carp is a rapid grower and a good food fish. I have young mirror carp hatched last March, a year ago, that today weigh 4 pounds. I have nothing but mirror carp. I have kept up with the quoted prices; I never pick up a paper that quotes the fish price in any market. but what I look at carp and always find him selling at a good fair price; and in winter time he sells for possibly twice as much as during the spring. I am a North Carolina fisherman, and in fishing I caught carp in the sounds, and early in March I have realized as much as 20 cents a pound for them in the New York market—of course we did not catch many. I do not say they are as good as Spanish mackerel, but they are good, nevertheless.

Mr. W. De C. Ravenel: How large ponds did you raise crappy in?

Mr. Leary: A quarter of an acre. I have three ponds at San Marcos, Texas, of three-quarters of an acre each. The other fish destroy carp, but the carp do not destroy the other fish. Take the San Marcos river for instance: I know lots of our young carp escape during the floods, and several of the old carp, my brood fish, were caught with dough balls in the river, this spring. I believe he is a good and valuable fish and growing to be more popular all the time. He is certainly an economical fel-

low, because he grows fast, and will furnish a large amount of food in a short time.

Mr. Charles G. Atkins, of East Orland, Me.: Can any of the gentlemen speak of the climatic influence on the growth of carp; for instance, if there is a northern limit where they cannot spread on account of cold? I am from Maine and I am not aware that they have established themselves at any point, and I wonder if it is because the climate is unsuited to them. We have tried to plant them in Maine, but have not succeeded as yet. Is the climate there too severe, and does anyone know how it is in Michigan or northern New York, for instance?

Secretary: Carp thrive in Wisconsin, which has about the same climate as Maine; we have the temperature as low as 30 below zero; and I know that in a certain marsh preserve where it is water and mud, and it freezes, as we fancy, solid in winter, and freezes all the other kinds of fish out, they thrive beautifully, and I believe they are pretty near frozen stiff—there cannot be any water left in there which is not frozen, and yet the carp thrive.

Mr. Atkins: I have an idea that they are found in Norway and Sweden, and if that is the fact they ought to thrive in Maine.

Mr. Titcomb: They exist in Vermont in two or three ponds; but they are not of any value there, because we have other fish which are more desirable, and people do not know how to catch them. I do not think carp will obtain as large a growth in a northern climate as in warmer waters; and in clear waters I do not think you need fear any bad influence from their introduction. I do not mean that I am opposed to carp in proper waters for them; I think that all the trouble that has arisen about the carp has come from the indiscriminate distribution which was made when they were first brought to this country; and today, if properly distributed, they would do a great deal of good. The United States Fish Commission is receiving daily applications for carp, mostly from the western states, Kansas, Nebraska, and out in that vicinity, where they have a great many warm water ponds; and I have no doubt in some of those places where from the description of the waters it is difficult to name any other fish suitable for them, that the carp is about the only fish they can raise in them.

Mr. Whish: Perhaps I can supplement what I have already said, by the suggestion, that in New York state the line fishermen do not like the carp. I might also note the fact that in the three years during which I have been connected with the Commission, there has not been a single application from anybody for carp, and we do not raise them any longer in any of the hatcheries.

Mr. Tarleton H. Bean, of St. Louis: I would like to say a few words about this celebrated introduction of carp throughout the United States. I have always been a champion of the carp, but speaking now as a newspaper critic of the fish, I object to it for a good many reasons.

In the first place it either has great big scales, or it has no scales at all, and it is not in good taste for it to parade around in that slipshod sort of way, neither one thing nor the other.

Another very strong objection to it (speaking now as a newspaper man) is, that it has no teeth in its mouth, but carries them like a comb, in its throat.

My friend Bartlett from Illinois has given you still another serious objection to it, and that is, that it takes the dough, and we need that in our business, especially we newspaper men. (Great laughter and applause).

But worst of all is a report sent to us by wire from Reading the other day, and that is this: A couple of Philadelphia girls were out fishing on a pond near Reading and they hooked something (as the girls generally do, you know, when they go fishing, (laughter); the first thing they knew they were in the water, and of course several gentlemen rushed to the rescue and got them out, and what do you suppose it was, Mr. Chairman—it was a great big carp! (Laughter). Now when a carp comes to taking away Philadelphia girls, and when it gets to be a question between Philadelphia ladies and the carp, I think that the carp had better go! (Great laughter and applause).

Speaking as a newspaper man, I have several other objections to urge against the carp, but I must save them up. He has been in this country so long he has got stuck up, feels important and big; he has a whole lot of eggs, his family are very numerous, he grows very fast, and people like to eat him, and I am afraid he will drive the cod out of the market, and what will we do with

out cod? Now I think the carp had better go down, down into the water and stay there. (Great laughter and applause).

Mr. Seymour Bower: One of the objections made to the carp is because he has got scales, but I think there is a way to get around that—at least I heard of an experiment in that direction. An old friend of mine, living on the banks of the Raisin, was in the poultry business, and with rather indifferent success, and he conceived the idea of raising carp in connection with poultry. So he built a few ponds and diverted a stream from the river to the ponds and got in a stock of carp. His scheme was that when he dressed his carp he would feed the offal to the chickens, and when he dressed his chickens he would feed the offal to the carp; (laughter) and of course, each would sustain the other. It was to be a sort of an endless chain arrangement, a kind of reciprocity scheme that promised big dividends. I saw John a few years after that and I said: "John, how did your combination hen-carp enterprise come out?" And he said, "it didn't turn out just as I expected; it worked first rate for a while, and I thought I had a fortune, and I would have had too, but those confounded chickens lost their feathers, and grew a coat of scales, and the d—d carp lost their scales and grew a heavy coat of feathers!" (Great laughter and applause).

President: That is a case of hen-pecked carp. (Laughter).

Mr. Seymour Bower: In Michigan, down in Monroe county, especially, where there was formerly a great deal of prejudice against the carp, it now has many friends; because fishermen have learned how to catch and hold them so as to make money out of them, which they are now doing; and where formerly they were cursing the carp, they are now sounding his praises.

RECENT ADVANCES IN LOBSTER CULTURE.

BY MR. A. D. MEAD

Of the Commission of Inland Fisheries of Rhode Island.

When this Society last met in Woods Hole in the summer of 1900, the Rhode Island Commission of Inland Fisheries, in collaboration with the United States Fish Commission, had just begun a series of experiments in the propagation of lobsters, which has been continued since that time with gratifying results.

It is perfectly obvious to anyone in the least acquainted with the life history of the lobster, that its greatest need of protection is during the first few weeks after hatching. The eggs themselves are very well protected by the female lobster until they are hatched, and the young, after they begin their life at the bottom of the sea, burrowing and hiding in holes and under rocks, are comparatively secure. For about two weeks after hatching, however, they are compelled by nature to swim in the water, and during this period their liability to destruction is not only greater than at any other period of life, but apparently greater than that of the young of other sea animals. Their size and bright color make them conspicuous, they lack means of defence, and the agility and, for that matter, the inclination, to avoid enemies.

One further circumstance make it particularly advisable to protect them at this time, viz: that the transition from the precarious swimming stages to the "lobsterling" stage, when they begin life at the bottom, is abrupt. With the third moulting of the skin, the form and habits of the fry suddenly change, and the free swimming fry becomes in about five minutes a crawling lobsterling.

The difficulty of confining newly hatched fry, of feeding them, and of preventing cannibalism, have baffled the many attempts which have frequently been made to protect them through this period. Every conceivable sort of car and enclosure has been tried, with scant promise of success. The fry, left to themselves, are inevitably carried against the side of the enclosure, or sink to the bottom, and perish.

The solution of this difficulty is a simple one. The water

must be kept constantly in motion so that the fry cannot sink, and so that the particles of food may be kept suspended and within the reach of the fry. This was suggested by the study of the movement and habits of the fry in confinement at Wickford, late in the season of 1900. Accordingly the last fry of that season (which, by the way, were a poor lot), were kept in motion by means of an oar, and the great increase in the proportion reared to the lobsterling stage was most encouraging.

In 1901 the stirring was done by means of slowly rotating propellers, which were placed in the cars and moved by a gasoline engine. The percentage carried through the swimming stages was raised, from a fraction of one per cent in the experiments of previous years, to fifty per cent in some cases.

In 1902 this apparatus was improved and extended, but the same principle was made use of, viz: that of stirring the propellers, and the results were far ahead of any of those of previous years.

In the first two years of the experiments, before the stirring method was used, less than 100 fry were carried through to the lobsterling stage. At Wickford the record of experiments is as follows:

In 1900, when the stirring with an oar was first tried, the yield was about 3,000.

In 1901, with the introduction of machinery, 10,000.

In 1902, with the improved machinery, 30,000.

The number of fry received during these years was diminished each year.

In 1900 the main problem before us was to devise an apparatus in which the lobster fry could be carried through the swimming stages in large numbers and in good proportion, and this problem has been solved. Incidentally, we might say that the apparatus is also effective in hatching lobster eggs. In designing the apparatus we have kept constantly in mind the possibility of its installation in any protected estuary on any desired scale, and at a comparatively small cost. All that is required in the way of an experiment station is a series of skeleton floats buoyed up by barrels or otherwise; the floats may be coupled together and strongly moored. The shafting for transmitting the power

from one float to another can be coupled with universal joints and sliding shafts.

It will be surprising if better results cannot be obtained in the future by means of improvements in the apparatus, and through general experience, and I would like to indicate two lines in which improvements should be hoped for. First, in perfecting the transmission machinery, and second, in protecting the fry from parasites such as diatoms and microscopic fungi.

Inasmuch as the lobster is, to a considerable degree, a migrating animal, its cultivation by private enterprise will require its confinement till it reaches the market size, and here several new problems present themselves. Can it live in confinement through the winter? How long does it require to reach the marketable size?

The first question has been satisfactorily answered by the experiments of the Rhode Island Commission. We have kept a considerable number of young lobsters through three successive winters, by sinking them in small cars to a depth of about eight feet in water which becomes quite fresh in the spring, and which freezes at the surface in winter.

The question of the rate of growth has not as yet been fully answered. In our experiments the most conspicuous feature of growth is its great variability; at any time after the first few months, lobsters of the same age are, some of them, twice the length of others. The largest specimens one year of age were three inches; two years, six inches; and three years, eight inches.

The full account of our experiments, with descriptions and pictures of the apparatus, is published in recent reports of the Rhode Island Commission of Inland Fisheries.

DISCUSSION OF MR. MEAD'S PAPER.

Mr. Titcomb: I do not know whether I understood the writer fully. I wanted to inquire if he stated how many lobsters he used to produce the 3,000 and 10,000 and 30,000 he speaks of there.

Mr. Willard: It is not stated.

Mr. Clark: If I remember rightly, three years ago, when the meeting of the American Fisheries Society was held at

Woods Hole, one of our trips was to Provincetown, to view the successes in lobster culture of the Rhode Island Commission in connection with the United States Commission. At that time there was some experimenting going on in the way of rearing, the same as this gentleman mentioned. Now am I to understand that this paper brings the lobster rearing up to date? Is that the idea—bringing that same experiment that we saw being conducted at the Wickford up to date?

Mr. Willard: Yes, that is the idea.

Mr. Clark: Then I understand it is not very successful yet?

Mr. Willard: I think considerable progress has been made, as 30,000 were turned out last year, as against one hundred three years ago.

Mr. Clark: I do not understand that that is 30,000 of the partially grown lobster.

Mr. Willard: Yes.

Mr. Ravenel: It is an increase of from one hundred to thirty thousand in three years. The point is to carry them through the moulting to the lobster stage.

Mr. C. G. Corliss, of Gloucester, Mass.: It seems to me that this experiment depends upon the number of fry used to bring forth this 30,000. That is the meat of the whole thing—of course if they took a million fry and finally succeeded in raising 30,000, it is a question if that is a success. Of course they have progressed as far as increasing the number is concerned; but until we know how many they took to raise such number, we will be uncertain as to whether it was really a success or not. I would like to know how many fry they started with.

Mr. Willard: I regret that our specialist on the lobster is not present; but we have shown a mark of progress in starting in with 100 and arriving at 30,000 in three years, but whether it is really a commercial success at the present time we could not say. We think however, by further experiments and by improved apparatus we can make the number much greater.

Mr. W. H. Boardman, of Central Falls, Rhode Island: Does not Mr. Mead say in his paper that the increase was from 1 to 50 per cent?

Mr. Willard: Yes.

Mr. Boardman: Then that certainly is a great increase.

Mr. Ravenel: He does not say that the increase is 50 per cent. He says 50 per cent in some cases.

Mr. Boardman: I think the proportion is very large that he raises now, that is, that there are very few of them that die. That is a big increase in the percentage.

BLOOD AS FISH FOOD.

BY DR. JAMES A. HENSHALL.

"For the life of the flesh is in the blood."—Leviticus xvii, 11.

Fresh blood, it may be said, is liquid flesh. It contains a large amount of albumen, and lesser quantities of fibrine, fat, and the salts of iron, lime, sodium, potassium, etc. It is food in its most concentrated form. When freshly drawn and allowed to stand it soon cools and separates into clots and the watery portion called serum—the clots being formed of the blood corpuscles and fibrine, and the serum containing the fats, salts, etc.

The separation of freshly-drawn blood into clots and serum can be prevented by briskly stirring it for several minutes, after which a film forms upon the surface, and by keeping it in a cool place it will remain fresh and in good condition for several days

I first began experimenting with blood as fish food two or three years ago, by using the blood from fresh liver, and putting it into the horizontal aerating screens at the head of the hatching troughs, and before the yolk-sac of the fry was absorbed. This was continued until the fry were swimming and old enough to be fed liver emulsion in the usual way.

It was owing to the problem of furnishing suitable food for grayling fry that induced me to try fresh blood from the slaughter house; and although the experiment is still in its infancy, the results, so far, are most favorable and gratifying. This season it has been demonstrated that grayling fry, as soon as they begin to swim, and when too small to take any other form of artificial food, will readily take fresh blood distributed on the surface with a feather.

In the feeding of trout fry, I have also substituted fresh blood for water to dilute the liver emulsion, with the result that they have done better than ever before, growing faster and stronger, and with less mortality. I have furthermore diluted with blood the mush for the adult stock fish. So far as we have progressed with this manner of feeding both fish and fry, the results are so encouraging as to warrant its continuance. The food prepared in the manner stated seems to be better assimi-

lated, and certainly it is taken more eagerly than when mixed with water.

It may be of interest to add that I fed the blood from fresh liver to 100,000 whitefish fry, soon after hatching, and continued its use for several weeks. The experiment was quite successful, as the food was eagerly taken and with evident benefit, for the fry exhibited decided improvement in growth and activity. I imagine that with fresh blood from the slaughter house the improvement would have been still more marked.

DISCUSSION OF DR. HENSHALL'S PAPER.

Dr. Henshall: This paper is very brief and is merely suggestive: it relates to experiments with blood as fish food.

Mr. Willard: Do you mean the Lake White Fish?

Dr. Henshall: The Lake White Fish.

Mr. Whish: I do not desire to occupy too much time, but I can say that the state of New York is paying about $500.00 a month for fish food, and if blood can be obtained and used successfully I should judge off-hand that the reduction in cost would be about 50 per cent. Certainly some of the older members here, who have had experience in feeding fish, ought to give us some facts on this subject.

Mr. Titcomb: I have tried blood as fish food, and I agree with Dr. Henshall that it is very good for fry in the very early stages. It is usually very difficult to get it in the vicinity of hatcheries, but where it is possible to get near a slaughter house, it is a cheap and good food. Blood in the country slaughter houses goes to waste, and all they require is that the fish culturist collect it himself or pay the expense of collecting it. You stirred it while it was warm, did you not?

Dr. Henshall: Yes, sir.

Mr. Titcomb: You have to stir it while it is warm, to prevent it coagulating; but I have an idea that it could be used quite extensively in the vicinity of slaughter houses. I hope the doctor's idea of using it on the grayling will solve a problem there of rearing the grayling, which has not been solved, unless the doctor has solved it this year.

Dr. Henshall: It is too early now to say much about it.

Mr. Clark: Do you say you have not solved that problem?

Mr. Titcomb: Only for a small percentage.

Mr. Clark: I thought perhaps from your remark that you meant to say that you did not rear them at all?

Mr. Titcomb: Oh yes, we have reared some of them.

Dr. Henshall: The great difficulty has been coagulation. But my butchers take it from the animal immediately after it has been slaughtered, they catch the blood in a vessel and stir it briskly while yet warm, producing a homogeneous mixture, and preventing the objectionable separation into clots and serum. By this process of briskly stirring for several minutes the blood will become a homogeneous liquid with a film on top, and by keeping it cool one can preserve it for several days. Where it is convenient to try the experiment I wish you would do so next season. I find that it is the only artificial food that I have succeeded in feeding to grayling at first. Heretofore we have had to provide natural stream water wherein they could find natural food. When first hatched they are only about the size of mosquito wigglers and should be fed the smallest food possible.

Mr. Clark: I should infer from the doctor's paper and what he says, that the one great object in using the blood is its cheapness—not that it is any better than good beef liver.

Dr. Henshall: I think it is better.

Mr. Clark: We raised some grayling fry on liver. Perhaps 500 or 600 out of 5,000 or 10,000, and there was nothing fed but beef liver, we have not fed anything but beef liver in our hatcheries. Some of the older members will remember that I spoke of it at our last meeting. These fry were grown to weigh from one to two pounds, and never had anything but liver.

Dr. Henshall: But you had natural stream water.

Mr. Clark: Natural spring water, and the grayling were raised in spring water.

Dr. Henshall: They would not grow in my spring water.

Mr. Clark: We raised them on liver exclusively, and some of them were sent to the Pan American Exposition at Buffalo, where Mr. Ravenel saw them. Of course the advantage in the blood is perhaps this, that in starting the fry let it be brook trout, grayling, white fish or anything else, it may be a little better on account of being finer, and they might get a quicker start;

but whether it would be better food for the fish as they get older, is perhaps questionable. Of course trying the experiment might determine.

Dr. Henshall: My point was that in diluting the liver emulsion the blood is thicker and better than water, and contains much nutriment. Stir the liver well with the blood. My spring comes from under the Rocky Mountains, and there is neither air nor food of any kind in it. Your spring water probably flows from some little distance?

Mr. Clark: Oh no, it does not. The trout we raise (and I have some of them in my pocket, and you have seen them) were fed liver. Those trout have had nothing but raw beef liver—except the little that they may have been able to get out of the ponds where we put them about a month ago—and they have been fed five months. I have the record right here.

Mr. Titcomb: I would like to inquire of Mr. Whish what he feeds at his hatchery?

Mr. Whish: Beef liver.

Mr. Titcomb: Did you ever try hog's plucks?

Mr. Whish: No, we have always used beef liver.

Mr. Titcomb: Very many culturists are using hog's plucks when it is possible to get them. Hog's livers are about half the cost of beef livers.

Dr. Henshall: I used sheep's liver to a great extent, which costs about one-fifth as much as beef liver. It does very well for larger fish; but being soft does not grind so well, and is therefore, not quite so good as beef liver.

Mr. Clark: We feed hog's liver from the time the fish are a year old and on, but before that I do not like hog's liver in the water—it gives it a milky appearance all the time, and much of it goes to waste. We pay 5 cents a piece for hog's liver and 5 cents a pound for beef, and I think at this price that the beef liver is more profitable, because we get better results for what we pay.

Mr. Atkins: I have been using at the Craig Brook Station in Maine for several years mainly hog's plucks. I use them not because I have thought that they were better than other foods, but because they are more readily attainable in good condition, and are cheaper, and I will not undertake to say that they are

any better than some other foods, or perhaps as good; and the only point I can urge in their favor is, that the fish appear to grow well and be healthy on them, and that they are cheap. As to the cost, I have here in my notebook the figures. Last year, 1902, between May and October, that is the principal season of our feeding, we had a stock of fish in which the number of fry have averaged 447,000, that is to say, that is the mean between those we started with and those we closed with; and the fish, one to four years old showed a mean of 5,400, and the amount of hogs' plucks (it was nearly all hogs' plucks) used, was 25,241 pounds; actually fed to the stock 16,408 pounds; cost $262.52. We fed 447,000 fry on the average from May to October, giving us a cost of four and one-half mills per fish, or per 1,000 fish, $4.56. I rather think that is the cheapest we have ever succeeded in carrying any large number of fish through on.

Mr. Titcomb: Have you the cost when you fed beef livers, in comparison?

Mr. Atkins: No, sir, I have not figured this up.

Mr. Titcomb: Is it about twice as much?

Mr. Atkins: I would not dare to say off-hand—I would have to look that up.

Mr. Clark: Our expense bill will run from $15 to $18 a month for 25,000 fish, ranging from one and one-half to four or five years old, we feed beef liver to the smaller fish and to the yearlings, the yearlings taking at least half.

Mr. T. H. Bean took the chair.

Mr. Titcomb: I think it is a very important question from a financial standpoint, and the figures of course won't lie. We have these figures of Mr. Atkins, but we cannot compare them with yours, because the hatcheries are not located where the prices may range the same, but in comparison with the purchase of beef livers which he used previously. Mr. Atkins has made a great saving. Mr. George A. Seagle has made a saving at his station at Wytheville, Va., using hogs' liver, and Mr. W. F. Hubbard at Nashua, in his annual report this last year, gives a statement of a saving of $200 or $300 in the course of a year on fish food, without any evil results, apparently.

Mr. Willard: I understand that the American Fish Culture Company, of Carolina, Rhode Island, one of the owners of one

of the largest commercial hatcheries in New York, is using hogs' plucks almost exclusively at the present time, and they would not do that unless it was more economical.

Mr. Seymour Bower: We feed sheeps' plucks costing 5 cents a piece and the net cost is about 2 cents a pound. We prefer them to hogs' liver, which is softer and runs more to waste. Sheeps' liver is almost as firm as beef liver, and is the next best thing to it. It is also more economical, beef liver being very high. During about five months of the year, or in the summer, we alternate the regular food of the adult fish with what we call Lane's food, and Mr. Lane can tell you how it is made. There are corn meal, shorts and animal meal in it. We like it very well. It costs 1¼ to 1½ cents a pound, and the trout do well when Lane's food is fed alternately with liver.

Mr. Titcomb: Is that for the young fish?

Mr. Bower: No, sir, for the yearlings and upward. We do not feed Lane's food to small fish—we feed nothing but liver to the young fish. We think our larger fish are better off for not being fed entirely on animal food.

Mr. Seymour Bower: I would like to ask Mr. Wood what he feeds his fish at the present time, and what he thinks as to the relative cost and merits of the kind or kinds of food that he is using.

Mr. C. C. Wood: In the hatchery, at Plymouth, when we are feeding meat, we prefer to feed sheeps' plucks. We think they are better suited to the fish and not as soft as the hogs' plucks, and we get them from the West—they cost us 30 cents a dozen delivered at our hatcheries, with no charge for packing or anything of that kind, and that makes a pretty cheap food, and it is cheaper than anything we can get at Plymouth, and we like the sheeps' plucks better than any meat food. We feed our small fry on haddock spawn, and that makes excellent food; and we have good luck in raising fry; later on, during the summer we feed old fish costing us say $2.50 to $3.00 a barrel—old cheap fish that we grind up and feed the older trout. The sheeps' pluck, as I say, is the cheapest and best thing.

Mr. Atkins: From what point in the West do you get the sheeps' plucks?

Mr. Wood: It is a Boston firm, and I have never been able to pronounce it—S & S Company, on Commercial street, Boston.

Q. I suppose they get them from Chicago or western states?

A. Yes, I have no doubt but what they do.

Mr. Seymour Bower: A few years ago I think Mr. Wood told me they bought their sheeps' plucks for 3 cents a piece; but I cannot find a place in the West where we can buy them for less than 5 cents. We buy them direct from the refrigerator car of Swift & Company, which runs through where our hatchery is once a week. They are delivered in very nice shape, but that is the lowest price they ever gave us. I do not understand the reason for the difference in price. I guess we will have to order from Boston.

Mr. Clark: It is on the principle that our manufacturers sell goods in England cheaper than they do at home.

Mr. Bean: I believe Mr. Seagle has had experience in feeding fishes, and I think we would like to hear from him.

Mr. Seagle: We feed our small trout fry, herring roe, and have had some experience in feeding cod roe, but have not been very successful with cod roe. The fish lived but did not grow rapidly, and we quit it.

Mr. Bean: Did you ever try haddock roe?

A. No, sir.

Mr. Bean: Mr. George P. Slade, treasurer of the South Side Sportsman's Club of Long Island, and a new member of our society, is using haddock roe as food. His address is 309 Broadway, New York. He wrote me that the food proved to be very cheap and excellent for the young fry; that the fish grow faster and are less liable to disease than ever before. They had been using liver entirely, but last year they began using haddock roe and they are continuing it very successfully indeed. They get it from Boston.

Mr. George F. Lane, of Silver Lake, Mass.: I do not know that I can give you anything further than I gave you three years ago regarding the so-called Lane Food for fish. I have continued using that same food, as I told the Society at that time, with very good success; and I think if there is any such thing as a commercial fish tasting of the liver, that this feeding of the food

that I am given the credit of introducing, is a great benefit to the fish that you are going to put on the market for a food fish.

Mr. Titcomb: What do you feed the young fish?

Mr. Lane: Hog's liver.

THE LIVE-FOOD PROBLEM.

BY CHAS. G. ATKINS.

I think I may safely say that no fish-culturist disputes that live food would be better for fish than dead food if it could be had of suitable kind, in sufficient quantity, and at a reasonable cost. I am not aware that there has been any positive determination of this question by accurate research, but in the absence of such determination I think that we are justified in taking that view. Each one of the species of the family of salmonidae which form almost exclusively the subjects of fishfeeding work in America is plainly by nature a feeder on living animals; to such an extent is this true that seldom will one of these fishes pay the least attention to the most delicious morsel that does not have that most evident characteristic of the traits of life-motion.

The possible sources of live food may be broadly divided into two classes, first, aquatic animals; second, land animals. Amongst the former are other fishes, water-insects, shrimps, daphnids, and other crustacea, water-snails, etc. Amongst the latter are all the aerial insects with such of their larvae as are not aquatic, angleworms, etc.

Of the first group we may note that it comprises the entire natural food of fishes; and it would seem that search for a live food for the fish-culturist's broods should be first conducted along this line. What is there available amongst aquatic animals? The number that might possibly be of some use is so very great that a bare list of their names would take more time in the reading than I can afford in this address. I will therefore confine myself to a very few.

Most prominent among aquatic animals for our present purpose, are the small crustacea of fresh waters, the shrimps and the entomostraca and among the entomastraca, especially the daphnids or waterfleas. Some of these crustacea are present in every fish pond, however small, and under favorable conditions, which nature often gives them, they become very abundant. It is on these minute creatures that young fishes of the salmon family mainly feed in the spring and early summer. In many brooks

their influence on the growth of trout has been noted, and there have been some instances in America of fish-culturists availing themselves of their help in growing trout. In the transactions of this Society for 1892 there were some interesting statements from the personal experience of Mr. Fairbanks of Illinois on the growing of trout in ponds in which they were sustained solely by the natural food which grew there spontaneously, consisting mainly of freshwater shrimps; and the same matter has been discussed in some of the later transactions. I am not aware, however, that any attempt has been made to forward the multiplication of shrimps by any artificial help further than transplanting them from one water to another.

The crustacea which have received most attention are those belonging to the family of entomostraca called daphnids. Daphnids thrive in water containing much vegetable matter in a state of decay. Not that they feed directly on such material, but on the still smaller creatures that the decaying matter directly nourishes. Decaying animal substances would seem to work in much the same way, the multiplication of some of the entomostraca being eventually much favored thereby.

Fish culturists have always been scheming to utilize these aquatic food resources, but generally with unsatisfactory results. One of the most ambitious of these schemes was that of Lugrin and Du Roveray at Gremat, in eastern France, which was brought to American attention in 1888 by the American consul at Marseilles. His report and translation of a French report on the subject were published in the transactions of this society for 1892. As the consul depicted it, Lugrin's method was very simple and cheap and its results were marvellous. I quote his language: "The process of Mr. Lugrin, which has been patented in several countries, consists in spreading upon the bottom of these tanks a material impregnated with the elements necessary to produce spontaneously a limitless number of Daphnia, Cyclops, Limnaea, as well as fresh-water shrimps, and the larvae of various Ephemera which form the natural aliment of trout and other Salmonidae at all stages of their growth. Once constructed, and impregnated with this producing material—which is of trifling cost, (This reproducing material, it appears from the United States letters patent granted to the inventors, con-

sisted in nothing more nor less than the excrement dropped by the fishes in the ponds), these tanks go on with their work automatically and indefinitely. The water, from two to three feet in depth, being left undisturbed two or three weeks, is found peopled with swarming myriads of minute organisms of the species above named. Twenty thousand trout a year old, or three thousand two years old, which last would average about one-half pound in weight, are considered sufficient for a pasture of that size (160 square yards, or 1-30 acre), and the avidity with which they rush to occupy and ravage their new feeding ground is a delight to the pisciculturist. If the propagation has been ordinarily abundant, these 20,000 young fry or 3,000 yearlings will subsist royally in a tank of the size indicated for an entire month. They will eat on an average twenty to twenty-five pounds of food per day, or 600 to 800 pounds per month. When,at the close of the month the tank has become depleted, the gate is opened and the fish driven like a flock of sheep to a new and similar pasture. The first tank, being closed and left in quiet, immediately begins the process of reproduction, and at the end of two or three weeks is swarming again with the varied minute organic life which far surpasses in value, as food for fish, anything that has been devised by man."

The accounts of Mr. Lugrin's work attracted many visitors; and among them two eminent men in their departments, Prof. Francis Day of England and Mr. Raveret-Wattel of France, are on record as having, from personal inspection, reached the most flattering conclusions as to the success of the method and the great benefits that fishculture would reap from it. But I regret to have to say that their expectations have not been realized. The method of Lugrin, though pushed by the inventor upon the attention of fish-culturists in various countries, has not come into use, and appears to have been found wanting. In 1901, in a book on trout-breeding, we find this same Mr. Raveret-Wattel writing thus about the feeding of the fry: "The food of trout fry in captivity demands minute care and even that will not always avail to prevent heavy losses. One of the principal difficulties is that no artificial food can replace the living prey forming the food of fry that are hatched and live at liberty. When one is raising a small number of fry it is sometimes possible to pro-

cure daphnids enough to feed them. In this case one catches some of these minute crustaceans and with them stocks some casks such as are used in kitchen-gardens. * * * * * * * Unfortunately, the plentiful multiplication of daphnids is limited to water warmed by the heat of spring time and can only be applied to the feeding of trout fry in localities where this fish spawns late. Elsewhere one must resort to the foods called artificial, such as curd; yolk of eggs hardened by boiling; sheep's brains; blood, coagulated or cooked; chopped liver of beef or mutton; spleen, etc." Plainly in France the use of daphnids has not yet become an important practice in fish culture; and the same may be said of other countries. At Craig Brook the breeding of daphnids in fish ponds was tried about ten years ago and there appeared at first a prospect of important success; but though the little crustaceans were made astonishingly abundant, the salmon fry introduced into the ponds soon exhausted the supply and it was found impossible to secure its renewal, even though the fish were removed and the pond left to itself. It is a matter of common observation that the season when daphnids especially abound is always the spring and early summer, and it is reasonable to attribute our failure in part to the progress of the season. But Lugrin was able to show his visitors extremely abundant stocks of daphnids and accompanying forms in his ponds in October and again in winter when ice had to be broken to make the examination. I have myself known daphnids to come into a hatchery at Bucksport in winter with the supply-water in such quantities as to clog the flannel screens to the extent of overflowing. In this case the hatchery had just been built and the water supplying it came from a pond that covered a tract of low land now for the first time overflowed. So, although it may be true that the rule is with daphnids, to multiply and replenish the waters in the spring and early summer, and to pass the rest of the year in a dormant state, it seems to be quite within the limits of possibility that, if desirable, they could be produced for fish food at all seasons. I say *"if desirable"* because it would seem that the necessity of using such minute food as daphnids would pass away each summer with the growth of the fish, a trout or salmon having by midsummer become large enough to swallow comfortably an animal many times larger than an ordinary daphnid.

Of the many other aquatic forms that would be acceptable food for young fish, I will take time to mention only the larvae of mosquitoes and similar dipterous insects. In the summer of 1886 and again in 1888 at Craig Brook we practiced for some weeks the feeding of mosquito larvae and pupae to young salmon. At first they were obtained from pools in the neighboring swamps and later from barrels of water that had been set up in convenient places for them, and in which the adult mosquitoes laid the eggs. The fry ate the larvae with great avidity and throve well on them, but other methods of feeding came to engross our attention and the experiments were not carried far enough to develop any practical mode of operation. I, however, think it not improbable that some useful system of managing such larvae might be devised.

Now let us turn to the other division of the subject, the use of living land animals for fish food. First of all stand the larvae of flies. Those that have thus far been tried are almost wholly confined to the species that breed in animal matter, and especially the flesh-flies. At Craig Brook between 1886 and 1896 extensive trial was made of the production and use of these larvae. In 1891, fry of trout and salmon to the number of 158,000 were fed with them exclusively through the most of the summer. In later years, when 200,000 fry of trout and salmon were fed through the summer, maggots formed half their food. I have heard of no other attempts at the production of these larvae in America, that were developed beyond the tentative suspension over a fishpond of a box of meat in which the maggots grew and from which they crawled into the water. In Europe there have been numerous experiments leading in some instances to the invention of special apparatus for the purpose, but none appear to have reached the stage of practical work. One of the most prominent of these experimentors was Andreas Rakus, a practical fish-culturist of Austrian Silesia, whose methods, including the culture of many other kinds of live food, were taken up by an engineer, Von Scheidlin, who offered the secrets of the system for sale to American fish-culturists. That part of the system relating to fly-larvae became known as the "Von Scheidlin-Rakus method of odorless production of maggots." Von Scheidlin's description of it is as follows:

"To produce maggots cheaply and in great quantities upon vegetables and beef-blood. Moisture, shade and warmth are the fundamental conditions of the artificial production of insects as fish food. Maggots are produced (by the wholesale) as follows:

"Take a wooden box ½ to 1 meter long, ¼ to ½ meter wide and ¼ to ½ meter deep, wet the whole inside and strew it with sawdust or dry turf-earth so that these shall remain clinging to the walls, and then put in, from the bottom up, in layers of 6 to 10 centimeters, first sawdust or turf-earth, second sterilized (scalded or roasted) bran, third coagulated blood in pieces, together with the serum and chopped up frogs or fish, fourth chopped up plants or boiled mushrooms.. Then again in order, first, second, third, fourth, until the top. Then put the box in warm moist shade. In eight, twelve, twenty-four or thirty-six hours the flies will have deposited their eggs in the mass, and the moist warmth will have hatched them. Should a cold rainstorm occur, then put the boxes in pits in the earth upon fermenting horse manure, and surround them upon the outside with the same, and cover them so that the cool rain water shall not penetrate and hinder the hatching of the eggs. When the fish are being fed, the chest is to be emptied in standing water. In flowing water the contents of the chest must be put in tinned wire baskets having wide meshes, and loaded with stones and sunk to the bottom, otherwise the current will sweep them away."

Perhaps climatic and other conditions are such as to render this a cheap method of producing fish food; but in America the collection of a sufficient quantity of mushrooms to play any important part in the mixture would be impracticable, and the manual processes described would render it rather costly. I doubt, moreover, whether this scheme was ever carried out on more than an experimental scale.

The procedure with maggots at Craig Brook was in outline as follows: Animal substances, which had been exposed to the visits of the flies and received deposits of their eggs were put away in boxes, where the eggs were allowed to hatch and the maggots to grow until they had attained suitable size, when they were taken out and fed to young fish in troughs or small ponds.

The material used was of various kinds. Butcher's offal, plucks or haslets, horses or other domestic animals dying by acci-

dent or slaughtered on account of old age, refuse fish, either fresh or dried or salted, all these were used, as each became available. It was found that flies were much more readily attracted by fresh than by very stale material, and therefore anything that had already begun to decay was avoided; though, of course, in every case decay soon set in. In case of dried and salted fish they had first to be soaked in water, and even then the salted fish did not prove so attractive to flies as the fresh material. After the first experiments a house about 28 by 50 feet was built especially for the purpose. This was fitted with ranges of shelves on which were placed the growing-boxes. The boxes were in pairs, one within another. The inner box, smaller by several inches than the outer, had a wirecloth bottom and stood on four legs which held it up from the bottom of the outer box. On the wire bottom was spread a layer of hay, and on this was placed the fly-blown meat, which was generally covered by a light layer of dried loam to subdue the odor. Here the eggs hatched, the young feasted and grew, and in a few days, having attained full size, they crawled down through the hay and the wirecloth into the outer box, whence they could be turned out into a pail and carried to the fish.

The fry receiving this aliment were for the most part reared in wooden troughs a foot wide. At first the maggots were placed on small boards suspended over these troughs and left to crawl off slowly into the water, but later they were strewn in with spoons. They were always eagerly devoured and none escaped. Full-grown maggots were found too large for salmon or trout fry just beginning to feed, and though it was found possible to feed them with half-grown or smaller maggots, the practice finally adopted in the main was to feed liver for several weeks at the start. The maggot-feeding generally began in June and continued until October, when it was customary to liberate most of the fry. It was, however, found possible to keep maggots on hand in a cool cellar the most of the winter, dormant or slowly growing.

Fish fed on maggots have invariably made a better growth than those fed on liver or any other dead materials tried. Thus in 1890 the average weight attained in October by 18,367 salmon fry fed all summer on chopped meat was 45 grains; while 11,479

salmon-fry fed chopped meat until July 4 and maggots thereafter until October attained an average of 51 grains. In 1888 the average of some thousands of maggot-fed fish was 46 grains, against 35 grains for a like number fed on chopped meat. In 1891 the disparity was still greater, 53 grains to 35 grains, as an average of over 40,000 fish on each side.

Whether live food of this character will produce fish of better quality than dead food is a question that should await investigation; I do not mean simply better quality for human consumption, but better for the purposes of nature, making a healthier fish—one more likely to survive in the struggle for existence, and transmit desirable qualities to its offspring. From what has been observed of the influence of various foods I think the presumption fairly lies in favor of the superiority in this respect of this class of fish food.

I regret that I can cite no investigation of the availability for our purpose of the larvae of other than flesh-flies. There are, for instance, the house and stable flies, whose extreme abundance suggests the possibility of breeding and using their young. There are also species that breed in decaying seaweed, and research in other vegetable matter would doubtless reveal many other larvae, of which some might be available. A vegetarian feeder would surely be welcomed, as bringing relief from the disagreeable odors connected with flesh-eating larvae; but I do not consider it improbable that means will yet be found to suppress those odors in good degree while retaining the flesh feeders.

Like many other branches of the fishcultural art, this one of live food has received no thorough study, and presents a great field for future investigation; and as one offering the possibility of discoveries of the very first importance I commend it to all of you who have facilities for experimental work.

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Before reading his paper Mr. Atkins said: I took this subject by request, not that I felt myself in position to handle it as well as I would like to have it handled. My experience has not been sufficiently recent and up-to-date to expect that. I have tried to present in this paper the result of my own observations to some extent, and to glean a little from some other authorities, and hope that the paper may prove of some interest to you.

TRANSPORTATION OF GREEN BROOK TROUT AND SALMON EGGS, RELATIVE TO THE CAPACITY OF THE TWO SPECIES OF EGGS TO BEAR TRANSPORTATION OR ROUGH USAGE.

BY WALDO F. HUBBARD.

This paper is written in the hopes of bringing out some discussion upon this subject, and that members of the Association who have had experiences in this line may relate them. I do not claim to have made any new discoveries, and know that all of the experiments tried by me have been tested by others. But I do claim, as far as my observation and experience have gone, that brook trout eggs will bear transportation in the green stage with less loss than salmon eggs of the same age. What I mean by eggs in the green stage is eggs from one or two, to ten or twelve days old. When I was stationed on the Pacific coast, where I was for twenty-five years in connection with the salmon work, field stations for the collection of salmon eggs were operated in connection with the main station, and it would have often been very desirable if the eggs could have been transferred from these field stations to the main station while in the green stage, and I, at several times, tried a number of experiments with this object in view. As I remember, I shipped the green eggs of different ages by various methods. Some I packed on cotton flannel trays, others in moss, and others in glass jars of water, and I decided, from these experiments, that the eggs could not be successfully shipped until they were eyed, and they were therefore left at the field stations until such period.

In 1899 I was transferred to New Hampshire, where I am now stationed, and where the work consists principally in the propagation of brook trout, though other species are also handled. When I took up this work I gained the impression that brook trout eggs were more delicate than salmon, and, therefore, more difficult to handle, or transport. While in the northern part of New Hampshire my attention was brought to the method employed for several years by the New Hampshire Fish Commission in transferring their trout eggs from the field stations,

to the hatchery at Colebrook. The field stations are located ten or twelve miles from the hatchery, and the mode of procedure was, to capture the fish and strip them on the fishing grounds. The eggs, after being fertilized, and washed, were then placed in glass fruit jars filled with water. The jars were filled gradually as the eggs were taken. The work being usually done in the morning and the eggs kept in the jars, with an occasional change of water, till afternoon, when they were taken, by team, to the hatchery; thus being in the jars at least five or six hours. I do not know just what the loss, resulting from the transportation, was, but understand it was very small.

In 1901 the United States Fish Commission was operating a field station on Lake Sunapee, in connection with the Nashua, N. H., station, where both salmon and trout eggs were taken, and, as it would be quite a saving in expense, and avoid a considerable risk, if the eggs could be transferred while in the green stage, to the Nashua station, rather than be left at the field station until eyed, I decided to make the attempt to ship them in glass jars. The results were as follows:

On October 21, 1901, 15,000 brook trout eggs were taken from the field station to Nashua. These eggs were taken from the fish October 15, 17 and 20, therefore the oldest of them would be six days old at the time of shipment. The following day they were picked over and one hundred bad eggs, or about two-thirds of one per cent was found to be the loss. On November 9th of the same year 20,000 salmon eggs were taken from the station in the same manner to Nashua. These eggs were taken from the fish Nov. 5, 7 and 9, so at the time of shipment the oldest of them were four days old. When they were picked over 3,200 eggs, or about 16 per cent was found to be the loss. The following year, 1902, the same field station was operated and the same experiments repeated, with the result that of 16,100 brook trout eggs shipped to Nashua on October 24th, 330, or a little over 2 per cent was found to be the loss. These eggs were taken October 10, 16, 18, 22 and 24, so the first of them were fourteen days old at the time of shipment. On November 11th, 23,000 salmon eggs were shipped to Nashua, and the loss, when they were picked over, was 5,875, or a little more than 25 per cent. These eggs were taken Nov. 6, 7 and 10, and shipped on the

11th, so the oldest of them at the time of shipment were five days. The eggs taken at the Lake Sunapee field station were all handled in the same manner. After being taken from the fish they were placed in hatching troughs where they were kept for several days, in one case as many as fourteen, and until they were shipped to Nashua. At the time of shipment they were placed in two-quart glass fruit jars, the jars being full of water. The covers were then put on and the jars sealed tight. The eggs were placed in the jars before 12 o'clock in the morning, and did not arrive at the hatchery at Nashua till about 8 o'clock in the evening, therefore being in the jars all of eight hours, during which time they were not opened. The jars, containing the eggs, were packed in a box of hay with ice enough in the top to keep the temperature of the water down to about 40 degrees.

To recapitulate: The experiments made by me in Oregon resulted in demonstrating that it was not advisable to attempt to move green salmon eggs. The work done by the New Hampshire Fish Commission shows that green brook trout eggs have been transported by them, with small loss, for several years. The result of experiments made at the Lake Sunapee field station show the loss for 1901 in the transportation of green brook trout eggs to have been about two-thirds of one per cent, and of salmon eggs 16 per cent. In 1902 the loss of brook trout eggs was about two per cent and of salmon eggs 25 per cent.

I understand from J. N. Wisner, Field Superintendent, now in charge of the Clackamas, Oregon, station, and from J. W. Berrian, foreman of the Rogue River, Oregon, station, that at both places they have been successful in transporting freshly taken salmon eggs, in cans while they were in the milt, and before they had been washed, for a mile or two, from the spawning ground to the station, being perhaps two hours on the journey. This, of course, demonstrates that freshly taken salmon eggs can be transported successfully for an hour or two while they are in the milt and before they have been washed, but has no bearing on the question as to whether green salmon or trout eggs will bear transportation with the least loss when they are from one to twelve days old.

DISCUSSION OF MR. HUBBARD'S PAPER.

Mr. Titcomb: I want to inquire the temperature of the water the eggs were held in previous to shipping.

Mr. Hubbard: I could not give it exactly. The water was what we used in the hatching house.

Q. Pretty close to 32°?

A. Oh, no, it was above 40°.

Q. Then the eggs when they were six days old must have been in a very delicate condition.

A. Well, they did not appear to be from the condition they arrived in when they reached Nashua. I think that some of them were in a delicate condition. There were a few eggs that were there twelve to fourteen days old, that were in a delicate condition.

Mr. Clark: At what temperature of water, did you say?

Mr. Hubbard: I cannot say just what the temperature was, but it was over 40°.

Mr. Clark: I made a report six or eight years ago on the same line with the brook trout, when we had a field station for brook trout on the Au Sable river in Michigan, and I made some pretty thorough experiments in transporting green brook trout eggs, to arrive, if possible, at the exact time when they should not be moved, and I think in that report you will find that at a water temperature of 48° to 50° F. the brook trout eggs should not be moved at eight days old. These experiments were conducted as follows: The eggs were all moved about 200 miles by rail; we moved a certain portion of eggs, probably 50,000 to 100,000 each lot each day; they were taken, that is, within a few hours, and then every day from that day on until they were eighteen days old (of course eyed eggs). We found that on the 8th day the greatest loss occurred. The critical stage is about the eighth day, and we can move the eggs with perfect safety before reaching that period, and when that critical stage is reached we do not allow even the trays to be taken out of the troughs.

Mr. Hubbard: How are the eggs shipped—on the trays, or how?

Mr. Clark: The last year we moved about 30 million eggs, and most of them were moved on either flannel trays or cheese

cloth trays—I do not think it makes much difference what they are moved on, whether flannel, cheese cloth or wire trays. If you do not have any dead water around them and you have the temperature right I do not think it makes a particle of difference—I would just as soon move them on a board, if that board did not have anything about it that would contaminate or injure the eggs.

Mr. Titcomb: I think Mr. Hubbard's experiments are very interesting; but to carry them to a conclusion, in other words, to determine whether the transportation of the green eggs by the jar method, when they are from one to twelve days old is entirely without injury, we have got at the same time to eye some eggs right at the collecting station, and not only eye them there, but follow the results through to the young fish. I think that very frequently we get trout eggs to the eyed stage, they look all right, and they hatch all right, and then we have weak fry, and we do not know what the trouble is, and in many instances, I believe, although I have never followed a control experiment to prove it, the weakness in the fry and the mortality among the young fish are caused by a weakness in the egg, or possibly the weakness goes back to the parent fish, but will not be noticeable until the fish has begun to feed.

I just want to bring out in connection with this matter the point that many of the superintendents who are making experiments (and I place myself in the same category when I was superintendent), do not carry the experiments far enough; they do not have a test in comparison with the ordinary method. I simply bring that out for consideration, and in connection with your work another year, that you carry the experiments still further. There is no question but that you can take the green trout eggs and carry them long distances with very little injury. You can carry them almost any way. You can take an ordinary fish can and fill it half full of eggs and half full of water and put it on the cars and carry it all day, if you do not get your temperature too high. They get more or less aeration from the motion of the cars, and will go through all right and produce good fry.

Mr. James Nevin, of Madison: We always ship our eggs on wire trays. We fill the top of the tray full of crushed ice, and

have no loss from carrying them any distance—whether one day, ten days or two weeks old cuts no figure.

Mr. Atkins: We are in the habit of taking all our salmon eggs two miles from the station, and we transfer them to the station on wire cloth trays, to be developed. And all we have to do when we get them to the station is to take the whole bunch and set it right into the trough; and I have an idea that that could be done many days afterwards with entire success, if we are very careful to avoid jars. As long as we do not expose them far enough to dry them up and do not jar them, we might carry them almost any distance.

Mr. Clark mentioned one stage when he did not even take his trays out. We look them over every week, take them out of the trough, and handle them over, tray by tray; but we are careful not to jar them, and we do not find that we meet with any loss in consequence.

The point I wish to bring out is this, and the experiment that we tried, and I thought that we had it right, is, that in certain stages, with certain kinds of eggs, under certain temperature there is a vital time when we should not disturb the eggs. I think we can kill them then; at other times I do not. My experience has been that this jarring does not affect them either before that stage or after, and I think that a green egg, (that is, provided it is hardened enough—I do not mean an egg that is not hardened, but I mean an egg that is hardened) can be moved with impunity. I would move an egg one, two or three days old just as freely and with just as much jar as I would an eyed egg. But at the vital stage, as I have stated, this can not be done. I would like to ask Mr. Atkins if he has ever tried this experiment with eggs along at different times, picking a tray out and jouncing it in the water to clean it, as hard as he could?

Mr. Atkins: We have tried experiments similar to that.

Mr. Clark: Did you ever have a case like this: Take a tray of eggs, jounce it and pretty nearly every egg will turn white within a very few minutes?

A. Yes.

Q. You do not think that those eggs were all unfertile eggs, do you?

A. Oh, by no means—they were killed by the jar.

Q. Now, have you taken that same process and moved those eggs rapidly in the water after they were eyed, and did you find any trouble?

A. No, not after they were eyed.

Q. Did you ever try them one day, three or four days old?

A. No, I never did.

Mr. Clark: Then try the experiment this winter, and see if you do not arrive at a point when you should let them alone.

Mr. Atkins: There is a point when they are very delicate—we of course know that—and if the eggs are to be taken out of the troughs and handled at that time, it must be done very carefully indeed so as not to injure them.

Mr. Hubbard: Rainbow trout eggs we let lie for the first ten days and then we can handle them.

Mr. Atkins: Our apparatus allows us to handle them at any time.

Mr. Thompson: As being somewhat along the line of Mr. Atkins' remarks, I want to state that while I cannot give the exact figures, I can say in a general way that the eggs from the Sunapee Lake brook trout moved in the manner indicated by Mr. Hubbard have always been amongst the best we have handled at the Nashua Station. The fry hatched from them and reared to the yearling stage being amongst our best and strongest fish. This would definitely indicate that the embryos could not have been greatly damaged by shipping in the manner and at the period mentioned. After the first picking on arrival, there was but small loss of eggs, ranking invariably well up with our best lots; the fish were usually stronger than those hatched either from the station eggs or those received from the Commercial hatcheries.

There is one point I do not think was as well understood as it should be: Not only were the eggs under discussion shipped in fruit jars but after filling them to the top with water and eggs, a rubber band was put on and the jar cover fastened down so that it was absolutely air tight, the same as though preserving fruit. You know the result if air gets in fruit jars. The jars were then placed in the shipping boxes surrounded by packing to keep them from breaking and with a light covering of ice to regulate the temperature. For eight hours at least while in

transit to the station there was absolutely no possibility of their receiving any air in addition to that enclosed in the jar.

Mr. Titcomb: What I mean by "comparison" is this: You cannot compare them with the station eggs or the eggs you get from the commercial hatcheries; you have got to make your comparison in order to ascertain the relative merit of transporting those eggs green or young, by eyeing a part of them right where they are taken, and then transporting the balance, getting the comparisons from the same fish under the varying conditions. Undoubtedly the wild trout of Sunapee Lake will yield a stronger trout than the station fish.

Mr. Thompson: I only mentioned that in a general way as it has some slight bearing on the subject.

Mr. Hubbard: I might say that I have had such good success with the jars from the beginning that I have not tried any other way of shipment, as for instance, in trays.

Mr. Clark: How long have you kept the fish in the jars?

Mr. Hubbard: About eight hours.

Mr. Clark: In our work on Detroit river, all our fish eggs were moved from the field station to the hatchery, in cans. They are sometimes taken in the afternoon and do not reach the hatchery until the next forenoon, and are held in cans all that time. The change of water while they are at the field station in tubs. is made every hour. When they are put in the cans it is not intended that they shall be kept there longer than three hours.

Mr. Atkins: Is there no change made during that three hours?

Mr. Clark: No sir, except what little aeration there is in the winter. I think in Mr. Hubbard's experiment if the water is at a proper temperature there would not be a particle of difficulty in sending them in those cans, if you did not have too many eggs for the amount of water.

Mr. Hubbard: They were in two-quart jars, which were probably two-thirds full of eggs.

Mr. Clark: I think there is a point in the sealing business. I conducted an experiment with fish along that line.

Mr. L. B. Handy, South Wareham, Mass.: I take the eggs, pour them right into the pan, not letting them be in water over

half an hour, and turn them about 20,000 at a time on the tray, and ship them.

Mr. Clark: Will they come up full size in thirty minutes?

Mr. Handy: Yes, sir, all right. At 9 o'clock in the morning I put them on the tray, and some of them are not taken off until 9 o'clock at night, and they have just a moist cloth over them. I have moved six or seven million of them in the last four or five years that way. When I take them in a jar I find I have a much greater loss from dead water, etc., than by the method which I employ. They do better with no water at all—perfectly dry—than in the way suggested.

Mr. Clark: They must have clear water down our way.

General E. E. Bryant of Madison: I would like to inquire if the deduction from the discussion would be that the mortality of the eggs arises largely, or might arise, from two sources, one, that when they are at a certain critical or sensitive stage, any jarring or throwing them into contact, would impair the virility of the egg; the other, the water becoming stale. Is not then the method which should be resorted to that of the greatest care in handling, to avoid any shock or jar, any bringing of the eggs into forcible contact with each other, and keeping the temperature even and at the degree desired? We know when water becomes stale it becomes infested with myriads of microbes of a bad character; and it would seem to me from the discussion here (and I speak not from actual experience) that the shock or jar was very detrimental to the egg. Is not the problem then to avoid the least shock and to get the temperature right, and to obtain purity of water, if you transport them in water? I merely throw these suggestions out for inquiry.

Mr. Atkins: It seems to me those are the two important points, certainly, to avoid any excessive jar, and also to avoid stale water. I should think that Mr. Hubbard would need, as Mr. Clark says, to extend his observation on those eggs to the hatching and the fry afterwards. I should suppose that it was possible that eggs might be carried in water and show no immediate injury, and show no trouble in hatching, and not until the fish were considerably developed, and then show some weakness as a result of the confinement in water allowed to get stale; but of course Mr. Hubbard had an opportunity to see whether these

trout came out right and what character they were, and he can tell us; and as I understand him he observed no injury whatever.

Mr. Hubbard: We had a chance to observe the trout after they hatched, of course.

Q. Those very same ones?

A. Yes, sir, and they were some of the best fry in the hatchery.

Mr. Atkins: That is pretty conclusive.

Mr. Hubbard: I wanted to find out in this discussion how salmon or green trout eggs would bear transportation with the least loss; I do not know if it is very important, but it is quite interesting to me as I had not been able to find means to ship green salmon eggs, and I was very much surprised to find when I came here that the trout eggs would bear transportation with less loss than the salmon eggs.

Dr. Henshall: I made some experiments with grayling eggs when I first began the grayling work in Montana, in order to find out the best time for shipping the eggs, and I have shipped green eggs from the sub-station after shaking and washing them well, for grayling eggs require much more washing than trout eggs, or they will adhere—and after the eggs had a good washing and a chance to absorb all the moisture they would, they were packed on trays in the usual way, and put in my refrigerator cases and shipped to my hatchery with a loss of about 25 per cent. The rest hatched out and made good fry. Those were perfectly green eggs, shipped the same day they were taken. I do not know that I am in order, because I did not hear the original paper, but you were speaking of salmon eggs and trout eggs, and that is my experience with green grayling eggs. We now ship them in less than five days after they are taken.

Mr. Clark: What was the water temperature for that five days?

Dr. Henshall: About 52° F; the eye spots will show in six to seven days, but the embryo is very lively in about five days, and that is a good time to ship them, as they do just as well as when the eye spot shows.

Mr. George F. Lane, Silver Lake, Mass.: My experience with trout eggs at a temperature of 52° is that they should not

be handled, after they have been in the hatching trough ten days; if they are touched after the tenth day they are almost a total loss. From the tenth to the twentieth day I do not think they stand touching, according to my observation.

SOME EARLY NOTES ON STRIPED BASS.

BY D. B. FEARING.

In collecting data for a history of the striped bass, I have come across a few remarks concerning him, amongst the early New England writers that may be of interest to the members of the American Fisheries Society:

The striped bass, as he is called here, received his scientific name of lineatus, from Bloch, in the latter part of the Eighteenth Century.

William Wood in New England's Prospect (London 1635) gives "Suggig" as the Indian word for "a Basse."

Josiah Cotton, in his "Indian Vocabulary," gives as the equivalent of "a bass," "qunnammag."

DeWitt Clinton, in a note to his introductory address, before the Literary & Physiological Society of New York, delivered in 1814, states that "Basse is a Dutch word, signifying Perch."

James Mease in a paper read before the same society, says that "The largest rock fish, that is, those that weigh from twenty-five to sixty pounds, are called 'Greenheads;' he also called them 'streaked basse.'"

Storer in his History of the Fisheries of Massachusetts says that "the larger striped bass are called squid-hounds, from the voraciousness with which they will take a squid, when used as bait."

There is a tradition that there were but ten species of fishes, known to the Dutch when they discovered America; that when they caught a shad, they named the fish "Elft," or eleventh; the bass, "Twalft," or twelfth; and the drum, "Dertienen," or thirteenth.

He is found as far north as the Gulf of St. Lawrence, and as far south as the Gulf of Mexico, on the Atlantic coast, and since his introduction to Pacific waters, in 1879, he has become common around San Francisco. He is usually called striped bass from New Jersey, north; from New Jersey, south, he is known as the rock, rock fish or rock bass.

William Hubbard writes in his "History of New England, from the year 1620 to the year 1680" (Mass. Hist. Soc., Collections 2nd Series V): "In the year 1623 they had but one boat left, and that none of the best, which then was the principal support of their lives, for that year it helped them for to improve a net wherewith they took a multitude of bass, which was their livelihood, all that summer. It is a fish not much inferiour to a salmon, that comes upon the coast every summer, pressing into most of the great creeks every tide. Few countries have such an advantage. Sometimes fifteen hundred of them have been stopped in a creek, and taken in one tide."

Francis Higginson writing in 1629 says: "Whilst I was writing this letter my wiffe brought me word that the fishers had caught 1600 basse at one draught, which if they were in England, were worth many a pound."

In his "New England's Plantation" or "A Short and True Description of the Commodities and Discommodities of that Country" (London 1630), he says, "There is a fish called a Basse, a most sweet and wholesome Fish as ever I did eat, it is altogether as good as our fresh Sammon, and the season of their coming was begun when we came first to New England in June, and so continued about three months space. Of this Fish our Fishers take many hundreds together, which I have seene lying on the shore to my admiration; yea, their Nets ordinarily take more than they are able to hale to land, and for want of Boats and Men they are constrained to let a many goe after they have taken them, and yet sometimes they fill two Boats at a time with them."

I find in Thomas Prince, "A Chronological History of New England in the Form of Annals" (Boston 1736), the following: "In the Morning, some of the natives stand at a Distance looking at us, but come not near till they had been a while in view; and then one of 'em holding out a Bass towards us, we sent a Man with a Bisket and change 'em. After which they supply us with Bass, giving a Bass for a Bisket, and are very friendly."

William Wood in "New England's Prospect" (London 1635), says: "The Basse is one of the best fishes in the Country, and though men are soon wearied with other fish, yet are they never with Basse; it is a delicate, fine, fat, fast fish, having

a bone in his head which contains a saucerfull of marrow sweete and good, pleasant to the pallate, and wholesome to the stomacke. When there be great store of them, we onely eate the heads, and salt up the bodies for Winter, which exceedes Ling or Haberdine. Of these fishes some be three and some foure foote long, some bigger, some lesser, at some tides a man may catch a dozen or twenty of these in three houres, the way to catch them is with hooke and line; The Fisherman taking a great Cod-line, to which he fasteneth a peece of Lobster, and throwes it into the Sea, the fish biting at it he pulls her to him, and knocks her on the head with a sticke. These are at one time of the yeare (when Alewives passe up the Rivers) to be catched in Rivers, in Lobster time at the Rockies, in Macrill time in the Seas. When they used to tide it in and out to the Rivers and Creekes, the English at the top of an high water does crosse the Creeks with long Seanes or Basse netts which stop in the fish; and the water ebbing from them they are left on the dry ground sometimes two or three thousand at a set, which are salted up against Winter, or distributed to such as have present occasion either to spend them in their houses, or use them for their ground. They drie them to keepe for Winter, erecting scaffolds in the hot sunshine, making fires likewise underneath them, by whose smoake the flies are expelled till the substance remaine hard and drie. In this manner they dry Basse and other fishes without salt, cutting them very thin to dry suddenly, before the flies spoyle them, or the raine moist them having a speciall care to hang them in their smoaky houses, in the night and dankish weather."

Thomas Morton in his "New English Canaan, or New Canaan, Containing an Abstract of New England" (Amsterdam 1637), says: "The Basse is an excellent Fish, both fresh and Salte one hundred whereof salted (at a market) have yielded 5 p. They are so large, the head of one will give a good eater a dinner, and for daintiness of diet, they excell the Marybones of Beefe. There are such multitudes, that I have seene stopped into the river close adjoining to my house with a sand at one tide, so many as will loade a ship of a 100 Tonnes. Other places have greater quantities in so much, as wagers have bin layed, that one should not throw a stone in the water, but that hee should hit a fish. I my selfe at the turning of the tyde, have seene such mul-

titudes passe out of a pound, that it seemed to mee, that one might goe over their backs drishod."

As early as 1639 the Colonists seemed aware of the danger of an extinction of their bass fishing, for it was ordered "At the Generall Courte, houlden at Boston, the 22th of the 3th M°, called May, 1639 . . . .

"And it is forbidden to all men, after the 20th of the next month, to imploy any codd or basse fish for manuring of ground, upon paine that every *p*son, being a fisherman, that shall sell or imploy any such fish for that end, shall loose the said priviledg of exemption from public charges, & that both all fishermen, or others who shall use any of the said fish for that purpose, shall forfect for every hundred of such fish so imployed for manuring of ground twenty shillings & so *pp*ortionably for a lesser or greater number; *p*vided, that it shall bee lawful to use the heads & offal of such fish for corne, this order notwithstanding."

Edward E. Bourne tells us in his "History of Wells and Kennebunk" (Portland 1875), "Bass and shad were also very plenty in Mousam river. They were taken in weirs which were built in different places. The most noted place was near the mouth of the river, a few rods above Hart's rocks, or near the old dam of 1792. But soon after the settlement was initiated at Kennebunk, the bass came to the conclusion that it was unsafe to attempt navigation in this river, and discontinued their visits to it."

Writing of Plymouth in 1643 Samuel Davis in his "Notes on Plymouth, Massachusetts; in the Mass. Hist. Soc., Collections, 2nd Series III. (Boston 1815), says: "There is a creek at each of these places (on the headland called Sayquish), where bass were formerly seined; a point there, is still called "stage point," where Mr. William Paddy, about the year 1643, and Mr. John Hewes erected fishing stages, with leave of the colonists. Places where bass frequented would be called "Suckake," hence the "Skekets" at Cape Cod; the word is derived, as we conceive, from "Kicous," the Algonkin generic term for fish; hence, in the Narraganset, bass are called "missuckeke," "much fish," or "great fish," as they are, comparatively, of the lakes; thus from "Kenonge," another generic term. "Hence we think, "Suckicag," the name of Hartford, Conn. It is, doubtless, the little bass

creek, there, which is intended, "Muskeget," too, an island near Nantucket, may indicate bass, for fish, we have "Miskenonge," "great fish," applied to the pike of the lakes; and it is also a river, on the map, not far from Montreal."

De Vries in his "Short Historical and Journal Notes of several Voyages made in the four parts of the World, namely, Europe, Africa, Asia and America" (Hoorn, 1655), translated by Henry C. Murphy, in his "Voyages from Holland to America 1632-1644" (published New York, 1853), gives us a different derivation of the name "twalft" for the striped bass. He says, "there is a species of fish which by our people is called the *twelve*, and which has scales like a salmon, and on each side six black streaks, which I suppose is the reason they call it twelve. It is the size of a codfish, very delicate, and good tasted for eating; the head is the best as it is full of brains like a lamb's head. The fish comes from the sea into the river in the Spring about the last of March and April and continues until the last of May. It is caught in large quantities and dried by the Indians, for at this time the squaws are engaged in sowing their maize, and cultivating the land, and the men go a fishing in order to assist their wives a little by their draughts of fish. Sometimes they catch them with seines from seventy to eighty fathoms in length, which they braid themselves, and on which, in place of lead, they hang stones, and instead of the corks which we put on them they fasten small sticks of an ell in length, round and sharp at the end. Over the purse, they have a figure made of wood, resembling the devil, and when the fish swim into the net and come to the purse, so that the figure begins to move, they begin to cry out and call upon the Mannetoe, that is, the devil, to give them many fish. They catch great quantities of this fish; which they also catch in little set-nets, six or seven fathoms long, braided like a herring net. They set them on sticks into the river, one, and one and a half fathoms deep."

John Josselyn in "An Account of Two Voyages to New England" (1638, 1663), published (London 1675), says: "The Basse is a salt water fish too, but not an end (sic) taken in Rivers where they spawn, there hath been 3000 Basse taken at a set; one writes that the fat in the bone of a Basses head is his braines which is a lye."

The Gazette, New York, November 14, 1758, mentions a law which was passed, to prohibit the selling or bringing certain fish called bass or twalft to the City in the months of December, January, and February. In consequence of the great decrease of that kind of fish, and of their being unsound and unwholesome in those months. "The penalty for such offence" was forty shillings lawful money of New York, " and a forfect of such fish." And if it be a negro, mulatto or Indian slave, shall receive such corporal punishment at the public whipping post as the mayor, recorder or aldermen shall think fit, unless the master or mistress shall pay the above fine.

The inhabitants of Marshfield, Mass., in 1762, also endeavored to regulate the catching of bass for, in that year, "At a town meeting was presented a petition of a number of the inhabitants respecting the catching B A S S in the North River, so called in the winter season, which petitioners applied to the General Court to prevent, was laid before the town and after due consideration thereupon, the vote was put to know the mind of the town whether an act may be passed in the General Court for the preservation of those fish and prevent their being thus taken in the winter season, and it passed in the affirmative."

Jeremy Belknap, in the "History of New Hampshire" (Boston 1792), writes: "The bass was formerly taken in great plenty, in the river Pascataqua; but by the injudicious use of nets, in the winter, this fishery was almost destroyed. After the mischief was *done,* a law was made against it; but the bass have never since resorted to this river in any great numbers. It is said by some, that fish which are spawned in rivers, and descend to the sea, return to those rivers, only where they are spawned. If this principle be true, the breed might be renewed by bringing some of the bass, which are caught in Merrimack river, alive, over the land, to the nearest part of the waters of Piscataqua, a distance not more than twelve miles. This must be done before the spawning season, and might very easily be accomplished."

"There was also, till within thirty years, a good *bass fishery* (at Exeter, New Hampshire), through the whole course of the river. But very great numbers having been imprudently, or rather *wantonly* taken in one season, they almost totally left it. For several years past, they have been returning to their old

haunts, though in small numbers. Could people be restrained from taking them through the ice, it is thought that the river might again be replenished with them, and the fishery restored. The legislature has passed an act for their preservation; but, through the inattention of those, whose duty it is to guard the laws from violation, it is feared that the generous intention will be frustrated."

Thus writes Samuel Tenney in a "Topographical Description of Exeter in New Hampshire, in Massachusetts." Historical Society Document Collections, 1st Series (Boston 1795) IV.

Charles Brooks in his "History of the Town of Medford" (Boston 1855), has the following anecdote:

"In 1776, a negro named Prince, was at work on the bank of the river (Mystic) opposite the shallow where the ford was, a few rods above the bridge, when he saw an enormous bass swimming very slowly up the river. The tide was inconveniently low for the bass, but conveniently low for the negro. Plunge went Prince for the fish, and caught him! No sooner was he out of water than a desperate spring, such as fishes can give, released him from his captor; and back he falls into his native element; Quick as a steel-trap, Prince springs upon him again, and again clutches him and lifts him up. The fish struggles; and Prince and fish fall together. Again Prince rises, with his prize in his arms, and then brings him ashore. It weighed 65 pounds. Prince thought that such a wonderful fish should be presented to the Commander of the American forces then stationed on Winter Hill. His master thought so too. Accordingly Prince dressed himself in his best clothes, and taking the fish in a cart, presented it to the Commander, and told the history of its capture; And the Commander gave him *six cents!*"

An Albany newspaper of June 10, 1852, says: "A bass of uncommon size, taken in our river, was yesterday brought to our market. Its weight was 55 pounds. We believe this is the largest fish ever caught in the Hudson, the sturgeon alone excepted. It was bought by Mr. Jared Skinner for four dollars and fifty cents."

The largest bass, of which I can find any authentic record, taken with a rod and reel, weighed seventy pounds. This bass was caught by Mr. William Post, at Graves Point, Newport,

R. I., July 5th, 1873. It was in very poor condition, long, thin, and emaciated. If it had been in good condition, it, undoubtedly, would have weighed close to one hundred pounds.

The largest average catch of striped bass, taken with a rod and reel, of which I can find any authentic record, is ten bass, weighing 58, 56, 54, 53, 51, 50, 49, 46, 42 and 36 pounds respectively, or a total of 495 pounds; making an average of 49½ pounds. This catch of striped bass was made on the 29th of August, 1881, between 6 and 11 o'clock a. m., with a heavy sea, and a rising tide, by Mr. Seth Barton French of New York, and Mr. John Whipple of Newport. It is with pleasure that I present to the American Fisheries Society reproductions of photographs of the large bass mentioned above, and also of the large catch of bass taken at the time mentioned.

Authenticated catches of bass weighing 125 pounds have been made in the Chesapeake, seine fishing. Several bass weighing over a hundred pounds have been taken with a hand line.

Probably the most successful introduction of a fish to waters previously foreign to it, has been the introduction of striped bass into Californian waters.

In the report of the United States Commission of Fish and Fisheries, for the year ending June 30th, 1893, we find the following:

The introduction of striped bass was accomplished in 1879, when about one hundred and fifty fish a few inches long, taken from the Shrewsbury river in New Jersey, were successfully carried across the continent, and deposited at the mouth of the Sacramento river by an agent of the United States Fish Commission, co-operating with the California commission. About six months later an example seven or eight inches in length was reported from Monterey, or one hundred miles south of the locality where planted, and in eleven months another specimen twelve and one-half inches long and weighing one pound, was caught in San Francisco harbor. This very rapid growth indicates the special adaptability of the waters of the region to this fish. In 1882 another plant consisting of three hundred fish was made in the same region by the California authorities. As a result of these two small deposits, the species soon became distributed along the entire coast of California. Its occurrence,

however, in the other states of the region, has not yet been determined.

Mr. James S. Turner, Secretary of the San Francisco Striped Bass Club, writes me, under date of December 17th, 1902, "last year more than one million pounds of striped bass were sold in the San Francisco markets."

In confirmation of this statement, the Hon. George M. Bowers, United States Commissioner of Fish and Fisheries, writes me under date of January 20th, 1903, "Statistics gathered for 1900 show 1,251,000 pounds in the San Francisco markets in that year."

With such phenomenal results achieved by nature alone in California, why should not our own coasts once more be made to teem with schools of striped bass as of yore?

Mr. E. M. Waterhouse (who read Mr. Fearing's paper): Mr. Fearing will be unable to come until later in the Convention and therefore he has asked me to read his paper. He took me away from the important matter of catching shrimp bait to do this for him.

Mr. Titcomb: Mr. Worth has collected some interesting material relative to the striped bass in North Carolina waters, and I think it would be proper to hear from him.

Mr. S. G. Worth of Edenton, N. C.: I have collected quite a good deal of interesting material relative to the hatching of the striped bass in North Carolina waters within the last three or four months; but I have been unable to digest that matter and get it into report form. I can submit it, however, in some kind of systematic shape now; so what I have to say tonight is, of course, off-hand.

Something that seems to me to be quite an interesting point is that the spawning habits of this fish first attracted considerable attention on the Albemarle Sound while the United States Fish Commission was operating in those waters. It was known before that time that the striped bass laid its eggs in North Carolina and that it had been successfully hatched in that state I think by Superintendent Green, who is present at this meeting. But when the United States Fish Commission ran upon this spe-

cies spawning at the fisheries at the headwaters of Albemarle Sound and brought in tubs and buckets full of eggs, they were amazed at the quantity and also at the successful hatching which resulted, and considerable attention was attracted to the subject, and it was talked about in Fish Commission circles a good deal. Cases of sporadic spawning of that kind have been noticed on those waters once in a great many years, as they have been in the waters of the Susquehanna river about Havre de Grace. Now had it not been for freshets occurring in the headwaters of those rivers I do not think the Fish Commission would have found those fishes spawning there at all. My observations at Weldon this year led me to believe that those fish were pushed off from the falls, where they naturally lay their eggs, by excessively muddy and cold water, resulting from hail storms and abnormally cold rain fall; so that in that way these fish were pushed out of a locality which the Fish Commission was not frequenting, and came under notice.

About ten or eleven years ago there was an extraordinary report that came up from Edenton, North Carolina, about a catch of striped bass in sturgeon nets. The fishermen in that locality informed me, I being one of their acquaintances, of having put out some sturgeon eleven inch mesh gill nets and catching great quantities of enormous striped bass which were in spawning condition; and it happened at that particular time that I was in a position to make a recommendation, and Superintendent Leary, who is now present, was sent down to Edenton to the headwaters of Albemarle Sound with a field plant, jars, etc., in order to take advantage of any second catch of those fish which might be made; but he was disappointed, and my inference is that it happened to be a favorable year in the Roanoke river for the fish to lay their eggs, and they were not pushed out of these upper waters by cold muddy freshets; consequently he was unable to get any eggs there.

This year on the 15th of April, a party under the direction of the United States Fish Commission office, I being in charge, went to Weldon and pitched a camp there composed of three canvas tents, and an examination was made into those spawning grounds with results that are extremely gratifying. At Weldon, which is about 140 miles from the lighthouse, at the mouth

of the river, or head of Albemarle Sound, the fall in the river is very great, perhaps fifty feet perpendicular in a distance about six miles; and it seems as if the striped bass make for those rapids on which they deposit their eggs. They go up there in the months of March and April, and if there is water enough they distribute themselves over the falls this distance of five or six miles. While they are in those falls they are practically inaccessible to fishermen. The river in this distance of five or six miles, where this fifty feet of fall takes place, is very rapid, and is full of islands, boulders, rocks, etc., and the current is so strong that it is apparently dangerous to go in there even when the river is at moderate stages, and when it is high it is really very dangerous; and these fish get up in these numerous channels that pass between the islands, and are inaccessible until the water begins to fall. When it falls to a certain stage the fishermen use finger traps and begin to take those fishes. They are swept out by the current on the finger boards and are captured. As soon as the river falls somewhat lower the fish become uneasy on account of the light covering of water on the falls, and drop below the foot of the falls at Weldon, and from that point down 2 miles there is fishing carried on with dip nets; they are after the manner of the shadskim nets; they are there called drag nets; and these nets are rigged on a bow, and one man sits in the bow of the boat and the other in the stern, paddling, and they float down the river one or two miles and then turn back. There are quite a number of boats engaged in this business, and they catch very considerable numbers of fish there.

With an inadequate crew of men this season—of course not knowing what our needs were there we cut things down as close as possible to determine what was there—from the 6th day of May for a week following we encountered the spawning fish, and I was amazed at the great quantity of eggs that we obtained from the individual fish, and also at the enormous field which seems opened up there for practical work by the United States Fish Commission.

Although the fish were extraordinarily numerous at Weldon this year they got into those Falls and the fishermen were unsuccessful in catching them, so that financially it was a very poor

year with them, as I have testimonials to prove in the form of letters—being the worst season in five years.

During this week beginning May 6th, we obtained and subjected to hatching process in hatching jars, 9,000,000 eggs in round numbers; they were estimated on the basis of 25,000 eggs per quart.

I was personally on this river and had the pleasure of taking the eggs from the first fish that was handled this year, which was by estimation a 20-pound fish. I took those eggs myself, impregnated them, washed the milt off of them, and watered them until they were brought up, carried them to the hatchery six miles through the canal from Roanoke Rapids to Weldon, saw them measured and put up in the jars, and they measured sixty liquid quarts, which on the basis of twenty-five thousand to the quart, would be 1,500,000 eggs, from that one fish! My recollection is that during that week there were twelve fish stripped. and the average production from those twelve fish was over 700,000 eggs per fish. That is correct data, on the basis of 25,000 eggs per quart.

There are one or two other points that I will mention. I wish to call attention particularly to one feature of the fishery at that point, which is in the nature of the spawning habits of that fish. For twenty years and more I have heard of the rock fish fight at Weldon, and although I had taken eggs there in two previous seasons about twenty years ago, I never witnessed a rock fight until this year; and this season I saw hundreds of fights, as they term them. When these female fish are in spawning condition the male fish gather around them in great numbers. There will be one big fish, which may weigh five to fifty pounds, as one of them did, which I took eggs from, and she will be surrounded by twenty, thirty or fifty small fish, and sometimes the fishermen will run one of their nets under and catch one of these large fish, and thirty or more of the small fish, and what seemed to be an interesting point in connection with that, is that the small fish appear to be the only male fish that mate with the female. They are known there as perch rock, because they are the size of a perch, and by actual weight they do not weigh as much as two pounds apiece, and yet they seem to represent practically about all there is in the way of male fishes. Those rock fights were in-

teresting. The fishes showed themselves on top of the water and flurried the water and made noises that would attract your attention, so that you would turn around to see the water breaking a hundred yards away. I thought before that that there was a good deal of imagination in it, but I know that it is a fact, and any one can witness it, and when that is going on it is the spawning season, which follows right on the heels of the shad spawning. The rock fish eggs are manipulated practically the same way as shad eggs, except that a lower tank head is required, and the eggs hatch in a period of thirty-six hours.

DISCUSSION.

Mr. Titcomb: Won't you explain the measurement of sixty quarts of eggs out of the twenty pound fish, the way they come up.

Mr. Worth: I had extraordinarily large spawning pans—I think they must have been sixteen inches in diameter—I had bought them at Weldon where the market is limited and had to take anything I could find. I took the eggs in fifteen pans, and ordinarily I should say that I could have taken in those fifteen pans the eggs from forty-five shad, easily, and yet from that one fish the eggs were so numerous that I had to take three more pans and spread the eggs out so as to hold them.

When the eggs are taken they are extremely small and of the most beautiful green I ever saw, and they are quite sticky. I poured water on them continuously while they were water hardening in order to keep them from clinging together.

The fish actually hatched and liberated from those 9,000,000 eggs amounted in round numbers to about 3,000,000 of fish; but our weakest point at Weldon was in the hatchery, where we were not properly equipped—we were short of men and the men in there did not know too much about the business. I had selected them on account of their grit rather than their experience. I think if it had been our second year and with the same conditions that we would have gotten 30,000,000 of eggs, and I believe that we are going to get an average of 75,000,000 or 100,000,000 eggs per season at about the same expense or a little less than running one of our shad hatcheries.

As for the transportation of the fry, it seems as if they would

stand any amount of it, but it is going to be a very brief season of work. It seems like swarms of flying ants or swarming bees—it all comes on at once.

Mr. Titcomb: I wanted to have the point of the size of the eggs before they come up, brought out—would not one or two of the pans hold the eggs from that twenty pound fish before the water was applied?

Mr. Worth: Yes, I think so easily—I think that one of them would, I am sure of it.

Mr. Clark: Are the fry free swimmers the same as shad or whitefish?

Mr. Worth: Yes, sir, and not more than three-sixteenth of an inch when they hatch.

Mr. Clark: They do not have a large sac?

Mr. Worth: They have a decided sac—they have so much that they look queer, but yet they are free swimmers.

Mr. Clark: They break right out of the shell and swim away?

Mr. Worth: Yes.

Mr. Titcomb: Won't you explain in the spawning process in the rock fights how this blood is produced which colors the waters?

Mr. Worth: It is assumed by all the fishermen that operate on the river that it is caused by the gashes made by the fishes finning one another in their attempt to get nearer to the spawning female fish. It causes a bloody stain in the water which I did not myself witness, but I know it has taken place, from the great number of persons who told me about it, and that the water was actually discolored with their red blood.

Mr. Titcomb: Do you think you could hold those unripe females in a large pool until ripe?

Mr. Worth: I think it is worth trying, but we made no experiment of the kind. The facilities for trying it are extraordinarily good there.

Mr. Titcomb: Well, if it is possible, you might figure on a thousand million eggs as quickly as a less number, couldn't you?

Mr. Worth: Yes. It is one of the richest egg fields that I know of.

Mr. Clark: What is the time of year of spawning?

Mr. Worth: About full moon, the first week in May, just after the shad.

Mr. Clark: Is the water pretty warm?

Mr. Worth: Yes, the water is about 70° F.

Mr. Clark: Are you not a little afraid in regard to the penning of the females that you might meet with the same difficulty that we found in attempting to pen the shad.

Mr. Worth: Very possibly.

Mr. Titcomb: What was the temperature at that time?

Mr. Worth: About 70° in the river.

Mr. Waterhouse: What is the method of transportation? It is not mentioned in the paper whether the fish are carried in jars or cans as trout fry are, or how have you transported them?

Mr. Worth: I do not know of any having been carried in cans at all. It has been done I presume, because quite a number were hatched on Battery Island on one occasion. They can be carried just like shad fry, and without difficulty, for I have held them for days in Fish Commission cans with but slight change of water.

Mr. Jones, of Erwin, Tenn.: The canning of rock bass was tried by the Fish Commission at Battery Station about two years before Mr. Ravenell was appointed superintendent, which was during the days when we had a large seine, and we tried to pen the bass and shad, and it proved a complete failure in both cases. The fish became scarred up, and fungused, and the whole experiment was a failure.

Mr. Clark: In the penning at Havre de Grace, we could hold the male fish but not the female. Only three were ever stripped, and they were practically ripe when they were put in the pen.

Mr. Titcomb: What I wanted to suggest about the penning was to hold them back by some arrangement similar to that used on the Pacific Coast with the salmon. I am aware that it would be entirely a gamble, because the river rises very quickly, but if it happened that during the short period of spawning, or perhaps a week or two longer, in order to get your fish, the river did not rise, by the use of salmon racks one would have a pool there very large in area, quite deep, with very swift live water running into it. I was wondering if it was possible in some such case as that to hold the rock fish for a week or two and get

those unripe females, because a very large proportion of them are caught and killed.

Mr. Clark: I think experiments in penning wild fish show that the success has been obtained only in the case of cold water fishes. Now with the pike perch I do not think there has ever been any real successful penning, that is holding them any length of time, and I do not think the Michigan Fish Commission ever had any success along those lines. If you will experiment I think you will find that in the case of pretty nearly all the cold water spawning fishes you can hold and collect their eggs, but with the warm water fishes I think you will have difficulty.

Mr. Jones, of Erwin, Tenn.: I will say that I too stripped a twenty pound bass and hatched the eggs successfully. As well as I remember we got something over a million of eggs. They came into the station rather unexpectedly and we constructed an apparatus for hatching them. We constructed a box similar to the old Chester cod boxes, with the tidal motion; and in the absence of suitable jars we used the ten gallon aquaria at Havre de Grace. We hatched the eggs and retained them at the station for about a week after they were hatched, and transported them for a distance of about six miles above the station, in regular transportation cans. We were, I suppose, about an hour on the trip; and they transported very nicely with no loss at all, so far as I could see.

Mr. Ravenel: I have been very much interested in Mr. Worth's observations, and if his statements as to the spawning grounds are correct and verified by experience, he has solved a very important problem in fish culture. As Superintendent of Battery Station from 1886 to 1894, and having direct charge of the station for several years afterwards, I made every effort to collect striped bass eggs in that vicinity where there was a most valuable fishery. I have seen 5,000 striped bass in one house in Havre de Grace apparently nearly ripe but only a few spawners were taken in that region, viz., head waters of the Chesapeake Bay during the period mentioned. Just after the shad season is over the boats there catch tons daily; we have never been able to understand why it was that the ripe fish were not found, though an occasional spawner was picked up at some of the fishing shores earlier in the season. The theory presented by Mr. Worth

is very attractive; and it would appear as though those sporadic spawners had been forced down by unnatural conditions up the river. If they do spawn in the Rapids, then I think that on the Susquehanna we will look for them up towards Port Deposit, Columbia, and the number of eggs available would be unlimited. I remember the eggs that Mr. Jones referred to, also the first ripe striped bass stripped at Havre de Grace in 1886 and 1887, I think we got 3,000,000 or 4,000,000 eggs—it was a sixty-five pound fish. The eggs were hatched and part of the fry were sent to some point in New York state, I don't remember where just now, but the records of the Commission will show it. Those fry were shipped in shad cans, just as the shad fry are sent.

Mr. Leary: Our fishermen have fished with pound nets in Albemarle Sound. They usually leave the nets in the water for a week and lift them on Saturday. Now if that can be done it seems to me that they might be held in a pen of some sort of material for quite a while. I know that to be a fact, that once a week they lift their nets and take the fish out and sell them. I have seen as many as 600 taken at one lift of the net.

Mr. Worth: I think we should have a barrier or fence to stop the fishes arranged so that they would not know that they were confined. Of course it is one of those things that is worth trying, as it would cost very little to do it. The water is so swift running that a man standing in it has difficulty in keeping his feet even where the water was only two feet deep.

Mr. Bean: I do not know whether the keeping of striped bass in aquaria for a term of years would have very much bearing upon this problem of spawning or not; but it is a fact very well known to many persons that the striped bass is one of the fish that can be kept easily and will grow, thrive and remain there free from parasites, fungus and disease of every kind—in fact it is one of the very best fish of the fresh waters for aquarium purposes. It has been kept in confinement for a long term of years. I know of some bass which must have been kept in New York City as long as eight years, which are in good health, feeding all the time when a fish will feed, (except in winter, when they are in a sort of torpid condition); yet I do not know whether any one has made any observation on the spawning of those fish. Perhaps they never have spawned in those aquaria.

The fact is, they can be kept in confinement with the greatest ease. Now, if they can be kept in a small pool, twenty-eight feet long and three feet deep, what difficulty could be presented in keeping them in a larger enclosure.

Mr. Ravenel: Are they kept in a fresh water pool?

Mr. Bean: The water is made alternately fresh and salt; they have been kept in fresh water as far north as this latitude; and they have been kept in Thunder Bolt Bay, South Carolina, and fed and reared to a great size.

Mr. Clark: It is not the fact of holding these fish and keeping the fish themselves in good condition that is important. The point is, will they develop the eggs. Now we keep the grayling in a pond for years and years, but has anybody ever domesticated the grayling and made a business of taking eggs from graylings in ponds? I know I have tried it a good while, but without success. It is not a question of holding the fish. There is no trouble about holding a great many fish, but the question is, can you pen those wild fish and have the development of the eggs go on until the ripe stage? For instance, last fall with our white fish why did we have a greater number of plugged fish than ever before? We had the greatest number ever known, either by Mr. Bower or Mr. Downing or Mr. Stranahan at his station.

Mr. Bryant: What do you mean by "plugged" fish?

Mr. Clark: Those that you do not get any eggs from. That is, the development has stopped and the vent is plugged. That is the common term. Last year the water was warm, and that is the reason we had so many plugged fish. There is no trouble in keeping the striped bass in good health and all that, but the question is when these fish are penned will they go on and develop?

Mr. Titcomb: You do not understand the kind of penning we propose to do. In this case in the river between the two falls is where the fish lie and spawn anyway; only part of them will go on through. Now what we want to do is to put a rack across in these Rapids. What is the reason they cannot live down there? They do not know they are penned until they get up against the rack—they hardly know they are confined.

Mr. Clark: I do not wish to throw any cold water on this project of trying to pen the fish; I recommend that it be tried. It should not only be tried in the way Mr. Titcomb suggests, but

you should try the actual penning in crates. It is well worth trying—but I do not think you will be successful—but that is my say so—I do not know anything about it.

Dr. Henshall: I want to refer to a remark Mr. Clark made about the grayling. I have about thirty graylings four years old which were stripped this spring—they were nearly all males, but the few females were stripped of their eggs which were fertilized and hatched.

Mr. Clark: Then that is the first time it was ever done?

Dr. Henshall: It is only a few, but it is enough to swear by. (Laughter).

Mr. Clark: Did you have any percentage of good fertilized eggs—have you a record of all those things?

A. Yes.

Mr. Titcomb: Is that in your report?

A. Yes.

Mr. Clark: Then it is the first time it was ever done with domesticated graylings.

Mr. Leary: Penning fish has a tendency to prevent spawning; they get excited and go round and round; but try the penning with some material that does not hurt the fish. If you put them in board boxes you will not get anything out of them—use something light and flexible that will not injure the fish.

LETTER FROM HUNTOON OYSTER COMPANY REGARDING SAMPLES OF SEED OYSTERS TAKEN FROM OYSTER BEDS AT SAMISH BAY, DAGGET COUNTY, WASHINGTON.

The Honorable George M. Bowers, U. S. Fish Commission,

Fairhaven, Washington, July 10th, 1903.

Mr. Henry O'Malley, Woods Hole, Mass.:

Dear Sir:—

By Great Northern Express (prepaid) we are today sending you as per above address, two boxes of samples, taken from our oyster beds at Samish Bay—an arm of Bellingham Bay, Skagit County, Washington.

This sample is submitted to show not only the great fertility and richness in native oyster seed of the waters of lower Bellingham, Bay, Skagit County, Washington, but to illustrate the method employed by the Huntoon Oyster Company in securing seedlings with which to stock their beds. Material used is cast-off Salmon netting. This particular piece was clipped July 9th, 1903, from a large section deposited in the water on August 20th, 1902. Scrap tin, bark, shells, gravel and other means for taking seed have been tested, but the results of the netting have been the most satisfactory, so far.

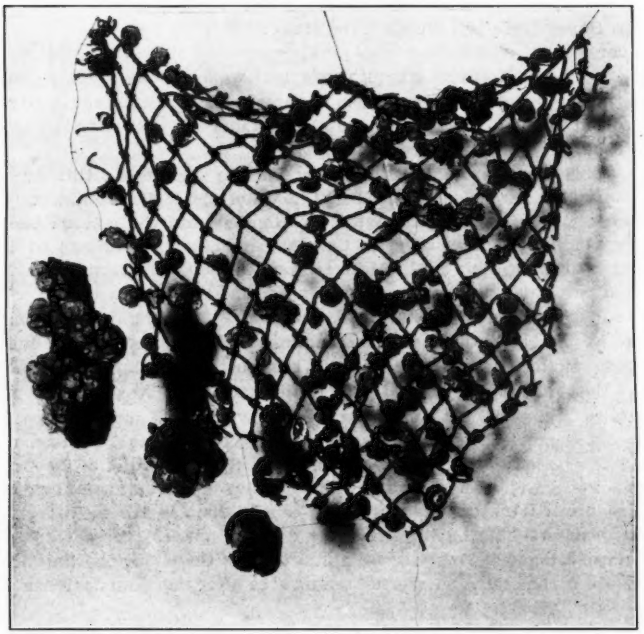
Both boxes are marked for "exhibition" and should be taken care of promptly on their arrival. We have packed them in moss as you suggested, but the journey is a long one and the specimens should not be allowed to remain in boxes till the exhibition opens up some ten or twelve days hence. The flat box contains a choice sample of our native oysters, as we caught them in the seed form, the clean webbing having been placed in the waters over our beds August 20th, 1902, so you must agree with us that their showing of growth is something wonderful, ten months after the plain "catcher" was set for spat.

The "catcher" used is cast-off or discarded salmon fishing material and we are fortunate in getting it here at a nominal cost, and its advantages over gravel, sand, bark or brush are many. The Department at one time recommended that we try scrap tin, but that did not seem to do particularly well for us. We are the only people who have tried to take seed with the webbing, but others will follow us this year. We are now spreading our webbing for July and August spat and shall have out over fifty acres, we believe.

We also send you specimen of native oysters taken on shells (clam shells) and on bark. The advantages of the webbing are that we can take the webbing with the seed thereon right to the beds we

wish to stock and there shake the young seedlings off on that particular ground without the great labor of picking, and then the web is all ready to place back in position for taking more seed. We propose to let the young seedlings remain on the webbing for a year and then by their weight they are easy to shake off and are large enough to grow and do well. For convenience in transplanting the webbing is the best scheme we have yet tried.

We are placing on our beds this year lots of shingles dipped in



lime and cement and setting them up in pairs, "cone" shape, and shall see if that is as good a method as the webbing. Webbing covers the ground very quickly and completely and at one-tenth the cost of gravel. Gravel and shells, when they become dirty and moss-covered, will not catch spat, but we can take the webbing out and clean it and save all the cost of restocking with gravel. We also show some of our two and three-year-old natives and also two and three-year-old eastern oysters. The Eastern specimens we show were grown on our beds from seed we bought in Connecticut.

We are very hopeful that we shall secure a catch of spat from

the Eastern oysters this year and we find many evidences that we have now a set of young Eastern oysters on our beds from last year's spawning.

If we succeed in this propagation of the Eastern oysters in our waters we feel that a great stride has been made in the industry. We are making special efforts along the line of securing seed from our Eastern oysters. The Huntoon Oyster Company was the first to plant Eastern seed in the waters of this end of Puget Sound, and they have done very well for us—have grown and fattened splendidly.

I am mailing you some maps of the Puget Sound country which will be of assistance to you in fixing locations of your Mount Baker plant as well as points on the Sound, when you come to talk with your fellow delegates at the meeting you are about to take part in. We will be very glad to have you make us a call on your way back to the Mount Baker Station, and if any of the Department's representatives are out this way we will be very glad to show them what we have and what we are doing.

If there should be any tests that the Department would like made we will be glad to have their suggestions, and if they send any seed to us for making experiments we will follow directions closely and report on the results. Yours truly,

CYRUS GATES,
Huntoon Oyster Co.

Duplicate of this letter sent to Baker, Whatcom County, Wash.

COMMERCIAL VALUES.

Some Notes of a Study of the Work of the Forest, Fish and Game Commission of New York State.

JOHN D. WHISH, SECRETARY OF COMMISSION.

Mr. President and Gentlemen:—

It gives me great pleasure to stand here as a member of the American Fisheries Society, bringing the official greetings of the Commission having charge of the Forest, Fish and Game interests of the state of New York. Some time ago our courteous and energetic secretary suggested that certain computations which we had been making would be interesting to this meeting and I trust you will find them so. You all know, as practical men, that while some of us are studying the problem of black bass propagation, or endeavoring to find a way to keep the lobster from becoming extinct, others must handle the no less serious problem of providing funds to carry on the work. Somebody must appear before the Legislative Committee and argue for the appropriation; somebody must be prepared to explain to the satisfaction of the inquiring tax-payer just what the people will get for their money, if the required sum is provided.

Over in York state we have a business man for governor, and he has appointed experienced business men as heads of the state departments, as far as possible. Therefore we have the question of income going hand in hand with the question of outlay, and this seems to be particularly the case in matters connected with the forest, fish and game interests. The result has been the confusion of our enemies as one or two practical illustrations will prove. Let me first call your attention to the forests, since these shelter and maintain the waters we stock with fish from our hatcheries. The Commission of which I have the honor to be the secretary, administers for the people a vast woodland estate comprising over 3,000,000 acres in the famous Adirondack region, over 80,000 acres in the historic Catskill mountains, and in addition an extensive pleasure ground on the St. Lawrence river called the International Park. Last year we compiled some statistics calculated to show the money value to the state of these

investments, and this was the result: We found that the railroads carried nearly 200,000 visitors to the Adirondacks and over 80,000 to the Catskills, who paid for railroad fares about $875,000. They spent in the Adirondack region alone for board, lodging and the various et ceteras of tourist life, over $5,000,000. Their comfort required the employment there of more than 13,000 persons who were paid wages amounting to nearly a million dollars. So you will see that our forest preserves are beyond attack as a profitable investment.

Now a few words on similar lines with respect to our hatchery system. It is a certainty that the majority of those who spend the large sums I have mentioned to pass a few weeks each year in the forests, go there to hunt and fish,—the most of them to fish. When the springtime stirs the blood, the busy men of our great cities recall the remark of the apostle of old, and seizing rod and creel say to inquiring friends "I go afishing." Most of the great army of summer visitors have the same ambition, and it is to restore to the inland waters the variety of fish necessary to meet this enormous demand that our extensive system of fish culture has been developed. Thirty-five years ago the people demanded that something be done to replenish the waters of New York state with fish. The result was a Commission, a $10,000 appropriation, and one hatchery under the direction of the famous Seth Green. They got quick returns for their investment and now we have a satisfactory system of eight hatcheries, several stripping stations and a distributing car, a plant which at a nominal inventory value is worth $112,000. The cost of running this plant, everything included, averages about $55,000 yearly. Let us see what the people get for their money.

Taking the last fiscal year which ended with the month of September, 1902, the returns from the hatcheries show that they raised and distributed a total of 128,672,516 fish of all varieties. (I may say in passing that the total has shown a considerable decrease for the past three years because of our adopting the policy of distributing less fry and more fingerlings and yearlings, a plan which gives much satisfaction and produces quicker results). Of the grand total distribution, 3,756,000 were trout fry of the various species; 984,150 were trout fingerlings and 284,366 were trout yearlings. The actual value of this product of our

hatcheries, estimated on a basis of the prices actually charged by several of the leading commercial fish farms of New England, is: Fry at $3.00 per M, $11,268.00; fingerlings at $20.00 per M, $19,683.00; yearlings at $75.00 per M, $21,327.45, in all $52,-278.00. If you add to this the cost of delivery which is estimated at fully half the value of the fish, the total is $78,278.00, which the people would have had to pay to stock their streams with trout if there were no state hatchery system. This item of itself shows a good return on the investment and the annual appropriation.

Now what of the remaining 123,648,000 fish of various varieties? In this total were 10,000 adult black bass taken from the wide waters of the canal when the ditch was emptied in the Fall. These certainly are worth the highest price charged for adult trout, and are figured at $1,000. The remainder figured at the minimum price for fry, after deducting 14,000 adult rock bass, would be worth at least $123,624.00, making the total value of the product of our hatcheries for 1902, without considering the question of cost of distribution, $176,902.00. It may well be doubted if any other work paid for out of public money can make a better showing.

We are unforunately not yet able to estimate the actual cash value of our inland lake fisheries, but statistics are now being carefully collected to show what these return. Thanks to the United States Commission we have been able to verify our figures on the Hudson river fisheries and find their average yearly value to be about $150,000. With these figures before them, we do not think any legislative committee can be justified in hesitating about making a reasonable appropriation, and it was to remove any such possible hesitation in the future that the figures were compiled. (Applause).

DISCUSSION.

Mr. Root: Is your Association the one that is propagating forest trees from seed?

Mr. Whish: Yes, sir.

Mr. Root: I heard that part of your report and was very much pleased with it. I think that there is a work that has not been taken up before; that the New York Commission are doing

a tremendous work in that line—in taking seeds from forest trees and sowing them and thereby renewing the forests. It is a part that certainly struck me as a great work; and I hope all the gentlemen will read that report, for that matter alone, if for nothing else.

Mr. Whish: We find that where there is no forest there is no water. Where I used to fish for trout twenty-five years ago in the Adirondack regions, the sections have been lumbered, and there is no longer any trout stream in the dry season. This last year we lost thousands and thousands of fish because the streams dried up. We had a force of men in the woods and whereever we heard of streams drying up, they would go and net the trout out and put them in other waters. That is one reason why we are trying to restore forest lands, on account of our water supply. A learned work has been written lately to show that there is no relation between the forestry and water. In New York state we think the author is mistaken.

Mr. Titcomb: We certainly do, that is right.

FISH ON THE FARM—WHAT SPECIES TO SELECT.

SAMUEL LOVEJOY.

Living in the red hills of Georgia and never having seen over a quarter of an acre of water is why I select the above subject. The pond should be placed on a stream or supplied from a good spring so as to have a constant supply of water. Side hill ditches should be cut around the pond so as to keep off the surface water during heavy rains, which would soon fill in the pond with clay or sand, although the occasional letting in of muddy water is beneficial, being healthful to the fish, and supplying fertility in which many ponds are deficient.

The area should not be smaller than one-fourth of an acre, though I have seen ponds do well with one-eighth of an acre and even less, where conditions were favorable. The dam should be built well with base ten or twelve feet if six feet high, tapering up to four feet at top. I have noticed a good many ponds in our section where the builder left all the brush in the pond, which is a great mistake, as it furnishes hiding places for fish enemies and makes it bad in case it is desired to capture the fish with nets. The pond should be cleared of all trees, brush, and planted with aquatic plants, not too dense. All ponds should be provided with an overflow or sluice, so as to draw the water entirely out of the pond when desired.

The speckled or mottled catfish, *Amiurus nebulosis,* is very productive, not cannibalistic at all, consumes any good wholesome food, is easily kept and weighs from one-half to three-fourths of a pound when one year old. I have seen it taken at three or four years old weighing from three to five pounds. It is an excellent fish for the table and market.

The blue-gill bream, *Lepomis pallidus,* does well in both northern and southern waters. It is very prolific, a rapid grower, a vigorous biter at the hook, nice for both table and market. Its abdominal cavity and head are very small and it, therefore, dresses to waste but little. It is splendid fish for small ponds. It will live and do well in water temperature up to 100°.

The third best fish, in my opinion, for small ponds south is

the warmouth bass, *C galosus*. It grows to much larger size than the bream, thick and fleshy, with large mouth, and is to some extent cannibalistic, but not enough so to make it objectionable. It will eat a few of its own young, but not enough to miss them—just enough to make the balance grow well.

The average weight of the warmouth bass is about one pound, though I have seen them weighing as high as five pounds. They are very easy to raise; will do well in water with a temperature at 100°. I have seen them taken from stagnant water. The warmouth bass resembles the rock bass, with red spots on eyes fore and aft, not as with the rock bass with red spots top and bottom of eye. These three fish are the very best for small ponds and will satisfy any one at the table or market.

One of the greatest mistakes is made in overstocking the ponds and then allowing them to remain so. I have seen ponds stocked with 500 fish and after they are two years old left to remain in the ponds. This is a mistake, after the fish begins to spawn the adults should be taken out as fast as possible so as to allow the young to grow.

Look well to the arranging of the pond and embankment. Then stock your small ponds with the three aforesaid fish and you will succeed.

DISCUSSION OF SAMUEL LOVEJOY'S PAPER.

Dr. Bean (during the reading of the paper): We look on the Warmouth bass as a small fish. The writer of the paper has seen them weighing as high as five pounds, and there is no reason to doubt it; because I have seen rock bass myself from a Virginia river that weighed over three pounds, but we look on the bass in the region in which it is native, western New York for example, and the Great Lake region—as a half-pound fish.

Mr. Titcomb: That is one of the most important subjects we have got before us in this country, I believe, today—I mean the question of fish farming or pond culture in states where they do not have the lakes and streams which we have in New England—out through the west, for example, and the southwest. The Commission is receiving inquiries upon this subject almost every day, about how to construct ponds, and what to stock them with. The main difficulty in writing a paper or preparing any

literature for reply to these inquiries rests in the fact that conditions differ so in different parts of the country. If we could get up a paper which would be applicable to all parts of the country, where people want to put in artificial ponds of from half an acre to fifteen or twenty acres in extent, or even larger, it would be one of the most valuable pamphlets for the use of the people at large throughout the country that could possibly be prepared; and in considering that we have to take local conditions into consideration, it is very desirable that we have papers just like the one that Mr. Lovejoy has written, from each state, to show the local conditions.

The main trouble with most people who construct these artificial ponds comes from the fact that they most always choose a ravine or some place that they can throw a dam across, and think they have got a pond, and the following spring they stock it and it goes out, and they are discouraged.

Dr. Bean: I would like to add a few words on that subject, because it so happens that my attention has been most forcibly called to the lack of good common market fish in a number of inland cities. For instance, in Indianapolis, not very long ago I was at a Lumber Convention at the best hotel in the city, and ordered what I supposed would be easily obtained at Indianapolis, because the state is so rich in that fish, a yellow perch, from the bill of fare. Well, the fish was simply uneatable. Now the same experience will be had by any one who goes to St. Louis, for instance, and attempts to order the fish which are indigenous to that state, the crappy, the bass, the Jack salmon, so-called, which is the pike perch, and other common fishes. You simply cannot get them except at the highest priced restaurants in the city. Now, there is no reason why such a state of things should exist, and I presume this is true of almost all the great cities of the United States, barring Boston, New York and a few other cities, which are noted for their fine fish markets; but it is a fact, as Mr. Titcomb has well said, that the ignorance about the methods of supplying the market with fish, and good fish, is deplorable. There is no excuse for it, as far as I can see, except that the people do not know how to get these fish. They have them, and it would be so easy to instruct them as to the methods. For example, we will take a gentleman who lived in Covington, Kentucky,

during the time of the Cincinnati Exposition—I have no doubt that Dr. Henshall will remember him—Joe Schlosser—he was a German who learned his fish culture in Germany. He came to Covington and settled in a region where nature made it easy for him to construct ponds, and the work was done at very small cost, because he was fortunate enough to have the graders who were making public improvements put their waste just where he wanted it to make his dams. He had his ponds at different levels and in connection with them he had a great ice-house. He could put his ice into the different floors of his ice-house almost without expense. Then he used those ponds for the rearing of Jack salmon, carp, bass, crappy, and a half dozen of other well-known and excellent table fish. He allowed people to come there and catch what they wanted at a reasonable fixed price. He was always ready to supply large quantities of fish and ice as well. I merely mention this to show that even on a large scale, as Mr. Schlosser conducted his business, it can be made extremely profitable. But the great want is this little bit of information, and I trust that the Federal and State Commissions will publish instructions for making ponds, and give us pictures of the fish that can be reared in those ponds, and describe their food. Of course I know that the United States Commission and some Fish Commissions have done a great deal of this work, but there is not enough of it, because if there were we would not have to go to Indianapolis to get a yellow perch and then not be able to eat it.

Dr. Henshall: I want to endorse every word in the paper just read, and to commend every one of the fishes mentioned. I am very well acquainted with them. When I was President of the Ohio Fish Commission years ago I introduced the marbled catfish. We turned the carp out and substituted the marbled catfish. It is a fish that grows fast, is very good for the table, and will live in any pond that the carp will, and the carp will live in any kind of water, stagnant or otherwise.

Mr. Titcomb: Is it what we call the speckled or channel catfish in Mississippi?

Dr. Henshall: No, it is the nebulosus. In regard to the Warmouth, I have taken them up to three pounds in southern waters. It belongs to the sunfish family, and is more nearly

allied to the black bass than any other fish, of that family. It will take fly well, takes almost any kind of bait, and is an excellent table fish. The blue gill exists from Canada to Florida—is another good fish and grows as large and round as a breakfast plate. It has a smaller mouth, will take the fly and is pretty gamey. Both the northern and southern crappies—the calico bass of the north, and the newlight of the south, are excellent pond fish. I do not know that they are excelled by any fish for ponds. All through Kentucky and portions of Ohio they exist naturally and have been transplanted to other ponds and always do well, and furnish a great deal of good food and fine sport.

Mr. Titcomb: For the information of those who may not understand about it, I would say that the Federal Commission propagates and distributes all of these species of pond fishes that have been mentioned. I will ask Dr. Bean about the wall-eyed pike and Jack salmon in the artificial ponds: how small a pond can the Jack salmon be grown in?

Mr. Bean: Mr. Schlosser's ponds were large wide ponds and very deep in some parts—they had twenty odd feet of water in some places.

Mr. Titcomb: What area?

Dr. Bean: Oh they were from two to five or six acres. I was surprised to find Jack salmon in those waters, but there was a fine water supply—in some parts from springs, but largely from surface water also.

Mr. Titcomb: Did the Jack salmon reach a good size in those small ponds?

Mr. Bean: Yes, sir, three, four and five pound fish.

Mr. Titcomb: Was there any quantity of them?

Dr. Bean: Yes, we had a lot of them. It was a surprise to me, and I think I reported upon it at the time in the Commission reports for about 1888—I know I did—because those things always caught my eye. If there were fish around that were good and I thought the people ought to know about them, I always reported them.

Mr. Titcomb: It is interesting to know that we can raise Jack salmon in small artificial ponds.

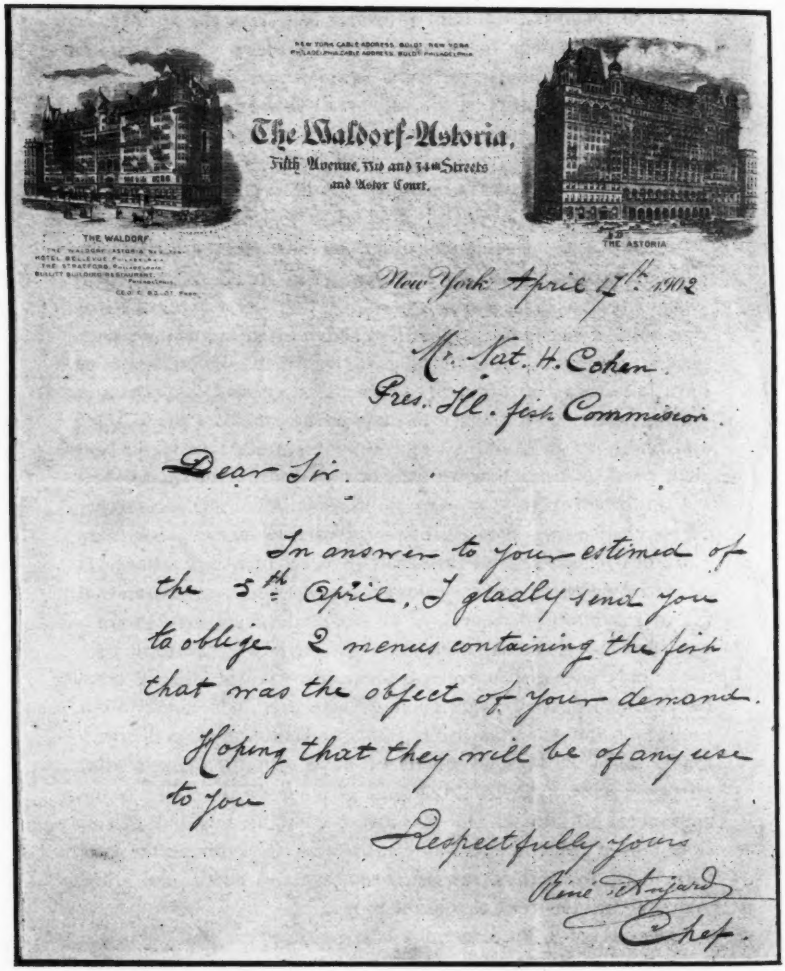
Dr. Henshall: The Jack salmon or wall-eyed pike is native to the upper Ohio and requires rather deep water, but the ponds

referred to were large enough and deep enough; but you will find many wall-eyed pike in the shallow waters of the upper Ohio, as you will find them in the Muskingum and Scioto rivers. I have seen the preserved heads of immense fish from the Ohio river, but they don't exist there now. The Kentucky river used to be famous for them, but since dams have been put in that river, the large fish have disappeared. You will find in the upper Ohio and tributaries, today plenty of wall-eyed pike. In regard to ponds, I only know them in the pond Dr. Bean speaks of, and I can endorse what he says in relation to that.

Mr. Seymour Bower: I would like to endorse all that has been said by the Doctor and others on this paper, which I consider very valuable. It does not cover very much ground, but it is right to the point, and it is certainly very suggestive. I think that most of the states pay hardly enough attention to the propagation and distribution of the common fishes. In our state we have hundreds and hundreds of small ponds and lakes, mostly private waters of a quarter to one-half an acre and up to three and four acres in extent. We have many applications for fish for such ponds. Years ago we took care of them with carp—there was quite a furore over carp twenty years ago. Almost every farmer had a carp pond in his front yard, back yard or barn yard, or somewhere; but there is little demand for carp now. It seems to me this paper is valuable because it gives information indicating how the owners of these small ponds may produce good fish at a very small expense. Of course in our state we cannot supply such fish ourselves, because we are prohibited from furnishing fish for private ponds, except carp, which we do not propagate, but it seems to me that our Commission and others might easily build some ponds of their own for experimental purposes, so that they could at least give out the necessary information. I venture to say we have, accumulated in our offices, from 500 to 1,000 or more applications received during the past four years, for catfish, sunfish, rock bass and perch, and other common varieties that we do not propagate.

Secretary: I have found a couple of papers that relate to the article of Mr. Bartlett of Illinois on the carp. He alluded to having written to the Waldorf Astoria Hotel, having heard that they serve carp, to find out if it was a fact, and he had an

electrotype of the letter made and sent on, and I will read it in order to verify his article.



Secretary: Here is the menu for Wednesday, April 16th, and I call attention to the item "carp, Rhine wine sauce," this

Cafe Luncheon

CAPE CODS 25 **LYNNHAVENS 35** **BLUEPOINTS 25**
Radishes 20 Beluga Caviare 1 50 Spiced Cantaloupe 30 Sardines 35 Stuffed Olives 30
Lyon Sausage 50 Celery 30 30 Pickled Beets 30 Thon Mariné 40 Anchovy Salad 50
Ripe California Olives 25 Pearl Onions 35 Spring Onions 25 Pin-Money Pickles 20

Cream Parmentier 50 30 **Sagou 35 20**
Petite Marmite 50 Chicken Broth per cup 30 Croûte au pot 40 Tomato Soup 40 25
Chicken Broth, Bellevue 60 per cup 30 Clam Broth per cup 25 Pea Soup 35 25
Strained Gombo 75 Chicken Okra 60 35 Mock Turtle 50 Julienne 40
Green Turtle 1 00 Mongol 40

Oyster Crabs 1 00 60 **Shad Roe 40** **Soft Shell Crabs 1 00** **Shad 30**
English Sole 1 00 **Brook Trout 1 00**
Carp, Rhine Wine sauce 65 40 Smelts, Melba 75 40 Kingfish, Bonne-femme 85 50
Bluefish, Italian sauce 70 40 Baked Halibut with cream 70
Fresh Mackerel, Maître d'Hôtel 65 Weakfish sauté with butter 65 40

Eggs Monseigneur 50

Broiled Mushrooms 1 00 **Terrapin 3 00**
Lamb Chops, Fremeuse 70 40 **Fried Calf's Brains, Tomate sauce 65 40**
Ham with spinach 65 40 **Aiguillettes of Filet, Poivrade sauce 85 50**
Navarin of Mutton, Padoleone 65 40 **Croquettes Panachées with green peas 65 40**

Roast Lamb 65 40 **Roast Squab Chicken 1 25** Roast Chicken 2 00 1 00
Roast Turkey 1 00 50 Roast Mutton 60 35 Roast Beef 50 40

Broiled Turkey 3 00 half 1 50 Broiled Chicken 2 00 half 1 00 Squab Chicken 1 25 75
Broiled Pullet 3 00 half 1 50 Squab 80 Duckling 2 00 half 1 00
Squab Guinea Hen 1 75 1 00

Canvas Back 4 00 Rail Birds 1 00. Red Head 2 50 Ruddy 2 00 Plover 75
Mallard 1 50 Brant Duck 1 50 Snipe 75

Potatoes Pont-Neuf 30 20 **New Asparagus 1 00** **Okra, German style 50**
Beets 30 Spinach 40 Sweet Potatoes 30 Cauliflower 60 Boiled Potatoes 25 15
Fried Egg Plant 40 25 Succotash 40 Squash 40 Fresh Artichoke 60
French Asparagus 1 25 Onions 40 25 Plain Rice 20 Stuffed Tomatoes 60
Braised Lettuce 60 Bermuda Potatoes 30 20 Lima Beans 50
Mashed Turnips 40 Fresh String Beans 75 Sweet Red Peppers 50
Stewed Tomatoes 30 Oyster Bay Asparagus 75 Cèpes 60

COLD

Game Pie 1 00 60 **Brook Trout in jelly 1 00** **Chaudfroid de volaille 1 25**
Lamb 65 40 Tenderloin of Beef 1 25 75 Squab Chicken 1 25 75 Chicken 2 00 1 00
Pickled Pig's Feet 40 Pickled Lamb's Tongue 50 30 Boned Turkey 1 00 60
Crab, Ravigotte 50 Ham 50 30 Virginia Ham 75 Westphalia Ham 75 40
Spring Lamb 1 00 Squab 80 Duckling 2 00 1 00

Watercress 40 25 Lettuce and Grapefruit 60 35 Waldorf 60 40 Lobster 1 00 60
Chicken 1 00 60 Russian 1 00 Romaine 60 35 Dandelion 40 Monk's Beard 40 25
Celery 50 30 Cold Slaw, Egg dressing 40 Cucumber 60 35 Tomato 60 35
Celery Knobs 40 25 Lettuce 50 30 Fetticus 40 25 Chicory 50 30 Escarole 50 30

Gorgonzola 30 20 Gruyère 25 15 Edam 30 20 Brie 30 20 Neufchatel 25
Cream Gervais 25 Roquefort 30 20 Philadelphia Cream 25 15 Port Salut 30 20
English Dairy 25 15 Camembert 30 20 American 20 15
Cheddar 30 20 Stilton 40 25 Canadian 25 Pont l'Evêque 30 20

Strawberries 30 30 King Tangerines 25 Oranges 25 15
Bananas 20 Apples 25 Malaga Grapes 50 30 Pears 60 35 Grapefruit 50 30

Cassava Pudding 40 25 **Kuemmel Omelette Soufflée 50** **Peach Pie 20**
Lemon Custard Pie 20 **Chocolate Baba 30**
Assorted Eclairs 25 Savarin 25 Baba 25 Charlotte Russe 25 Caramel Custard 30
Waldorf Jelly 25 Bar-le-duc Strawberries 40 Fruit Cake 25 Astoria Jelly 25
Assorted Cakes 25 Strawberry Short Cake 50
Bar-le-duc Jelly 40 Apple Pie 20 Pound Cake 25

Apricot, Pineapple, Raspberry, Lemon or Orange Water Ice 25
Strawberry, Vanilla, Coffee, Chocolate or Pistache Ice Cream 25 Mixed 30
Iced Coffee 30 After Dinner Coffee Cup 15 Café Parfait 25 Butter Milk 10
Half Portions are served in Café and to one Person only.
IOHANNIS-LITHIA 40 20

is on the menu for Wednesday, April 16th. They value carp in New York evidently. (Applause).

Mr. Clark: I think that should go in the proceedings with his report.

Secretary: Certainly.

Mr. Root: I think they put the carp so high that nobody will order it. (Laughter).

Mr. Seymour Bower: Perhaps it was the Rhinewine sauce that carried the order.

Secretary: It is an electrotype—it is genuine—there cannot be any question about it.

President: The date of the menu containing the carp is April 16th, 1902.

Mr. Seymour Bower: Referring back to the remarks of Mr. Whish, during the session of the Legislature last winter we had occasion to collect some information along the same line, and I recall one item that I would like to have incorporated in the proceedings. We addressed a letter to the Superintendent of a certain railroad asking him what he considered the value of the fishing industry to his road, and he wrote us quite a lengthy letter, stating that their management considered (and he went into the details) that it brought them between $200,000 and $300,000 a year for railroad fares alone—that is on one single road in our state, on account of the fishing and fishing resorts in northern Michigan.

Mr. Clark: We have half a dozen other roads equally as enthusiastic.

Mr. Whish: The foxy farmer of the Catskill region has discovered that a stream which has been stocked with fish is a valuable commodity, and he is fencing it off and leasing it to gentlemen who want private preserves, and the railroad companies are making the greatest kind of a kick about it. Just before I came away I received a letter from the attorney of one of the largest roads running in there, saying that something would have to be done to stop this. That is what our railroads think of the value of stocking waters. It is the law that wherever a stream has been stocked by the state of New York it cannot be included in

a private park, the water must be open to public fishing. That question is now being tested, and we are waiting very anxiously to see what the Supreme Court of the United States will say about it, because that is where it will eventually be carried.

THREE MAIN POINTS NECESSARY TO SUCCESSFUL BASS CULTURE.

BY J. J. STRANAHAN.

From comparative failure during the two former years of active operations at the Cold Spring, Ga., station of the United States Fish Commission, what might probably be considered a success was attained this year through the radical changes made in three important particulars, and it will be my purposes to confine this paper mainly to these points, which I consider cardinal, in fact, indispensable to successful pond culture and more especially to the production of young black bass.

As will be seen by reference to former papers and remarks presented by the writer to this association, he has been strongly in favor of distributing what has now come to be known as "baby fingerling" black bass. In his annual report two years ago and in special reports to the Commissioner for the past two years he has continually and persistently urged this course, giving as his reasons that all fish so distributed are so much clear gain, as there will be all or more fry left in the ponds after all of these possible have been taken out and distributed that the pond will furnish food for up to the fingerling stage. In these special and annual reports he cited the complete success attending the distribution of small-mouth fry by the Ohio State Commission fifteen years ago, where streams in which this fish were not indigenous became abundantly stocked through the planting of comparatively small numbers of fry.

Of course the conclusions arrived at at the meeting of this association at Put-in-Bay last year, when the Commissioner and his assistant in charge of the division of fish culture were both present, practically settled this question, for, if I remember aright, there was not a dissenting voice after the papers and discussion of the subject were finished, the admirable paper by Mr. Lydell, of the Michigan Commission, making the question practically a closed matter.

It is not, therefore, with a view of changing the opinion of any one that I give the following results at this station this year

but rather for the purpose of comparison and to let you all know how we are getting on down in this "neck of the woods." Up to this date, July 18th, 1903, we have distributed during this calendar year 125,420 black bass, of which about 90,000 were baby fingerlings, 1,000 fry and the rest fingerlings. We were badly crippled in our messenger service owing to the shad work in the early part of the season, or we would have distributed 50,000 more bass than we have and this is the reason also why more fry have not been sent out. When we had adequate messenger service baby fingerlings came along as fast as we could dispose of them. In passing I would state that the fry shipped as well as the older fish, although they were sent only about 150 miles. Now, after this distribution of 125,420 bass, we have in the station ponds today more fingerlings than we ever had at this season of the year, or, in the opinion of the attaches of the station. more than was ever before in our ponds at one time.

In concluding on this point I will say that had we twice or three times as many brood fish as we have, there being now 199 adult large mouth black bass in the station ponds, four in number, with a total area of three acres, and with sufficient messenger service so that we could have commenced early shipping fry, we could have easily added from one to two hundred thousand to our output this year, for with this plan of distribution there is no necessity of restricting the numbers of brood fish as would be necessary where only fingerlings are to be produced.

Our baby fingerlings carried practically as well as the fingerlings, in fact in one particular, much better, for by using ice moderately to maintain fairly even temperatures we have been able to ship 1,000 in a ten-gallon can, holding them thus forty-eight hours even in southern Georgia and Alabama in the month of July. Without a single exception, so far as I have been able to find out from our messengers, the applicants have been well pleased with the fish delivered to them, and this is pretty well attested by the large number of new applicants from the territory first covered which have been sent to the Commissioner, much of Georgia having been covered a second time and a new lot still being in reserve.

My next point is the absolute elimination of all fishes from the brood ponds except the species that you wish to propagate.

Even the top minnow, viviparous, which we had supposed to be the least harmful, was found by actual observation to be very destructive to black bass fry. Our best success this year has been where the minnows were the fewest, an effort having been made last fall to clean them all out. This will be repeated the coming fall, and not a living thing in the fish species, aside from the brood fish, will be left in the bass ponds, if it be possible to absolutely annihilate it. Our experience a year ago satisfied us that this should be done. Where we had the most minnows we produced the fewest young bass. Mr. Lydell, in his remarks at the close of the reading of his paper at Put-in-Bay, it will be remembered, advocated this course strongly, saying that he did not know of a minnow which would not devour bass fry when small.

The third point that I would wish to make is not so apparent as the other two, but if you wish to turn out a good lot of fingerlings it is especially necessary, and that is persistent and regular feeding during the breeding season. This is more essential south than north, for here our breeding season lasts over four months, beginning this year on March 1st, when the first eggs were identified positively, although there were several nests well out from shore on the last day of February, and several nests with good lots of eggs being seen on them the early part of July, this long season being caused, I believe, by the females spawning several times in a season, as we know they do here, while they likely deposit all of their eggs at one time in the north. If the fish are fed every other day about all they want and especially well when a rise in temperature follows a cold spell, when the fish will be found to have ravenous appetites, often rushing into a brood of fry and securing a mouthful in spite of the efforts of the parent fish to prevent it, cannibalism will be reduced to a minimum, so far as the adults are concerned.

During the rest of the year the brood fish should be fed enough to keep them in healthy, growing condition or they will not produce good results, and the feed should be mainly fish—— we use almost entirely cut mullet from the sea shore—our experience last year, when tadpoles were mainly used, having demonstrated that fish in some form is the best. Of course a change of diet is beneficial and we now give our breeding bass an occa-

sional ration of frog tadpoles which they devour greedily, but this section being very poor in fish life our range in this direction is exceedingly limited. Mr. Seymour Bower, superintendent of the Michigan stations, than whom there is no better authority, says that black bass fed persistently on liver will not produce fertile eggs.

If I were to add another point necessary to success, I would take up the question of cover. Several of our ponds are so poor in bottom soil that the ordinary vegetation of ponds in the vicinity will not live. We have tried fertilization with no success, the fertilizers all washing out the fist year and the vegetation dying. An experiment was last fall made with one of our largest ponds, E, in which we had utterly failed to make myrriophyllum and other like plants grow. About one-third of its area was planted to what is known south as parrot feather, which I have been informed belongs to the same family with myrriphyllum, the writer not knowing its scientific name, it making a much more vigorous growth than any other aquatic plant that I know of and growing such a swamp as to be very undesirable in ponds with fertile bottoms. In this sterile pond the parrot feather proved to be just the thing, making just sufficient cover to thoroughly protect both fry and fingerlings. This pond was a comparative failure last year, while this season it has produced abundantly and it is believed that there are 10,000 fingerlings in it at this time. The dense portions of the parrot feather is alive with fingerlings and has been all the season, the men getting good hauls with the seine by skirting the borders of the vegetation. Another pond of the same size and nearly as sterile, B, has produced as many broods of the baby fingerlings size as the one just referred to, but being almost devoid of vegetation it produced but very few fingerlings, and, when drawn down the other day, less than 200 fingerlings were secured, while a single haul of the seine along the borders of the parrot feather in E on the same day resulted in the capture of over 300 fine fingerlings. It is needless to say that every pond with sterile bottom will be thickly set to parrot feather this season, in fact, we are now at it as fast as time from other work will permit.

To recapitulate: Ship all the baby fingerlings, secured just before the broods break up, with us one to one and one-half

inches long, that you possibly can; keep all fish except the kind you wish to propagate entirely out of your ponds; feed enough to keep your parent fish healthy throughout the year and keep them full during breeding season in order to prevent them from devouring large numbers of what will make your fingerlings; see that you have abundant cover to hide your fry, baby fingerlings and fingerlings, and to make a good home for your adults and all else will come to you.

DISCUSSION OF MR. STRANAHAN'S PAPER.

Mr. Lydell: I consider that a very valuable paper and very interesting, and I wish to say that every word that Mr. Stranahan has said in there I believe in. I do not see anything in the paper to criticise.

Mr. Seymour Bower: I had some correspondence with Mr. Stranahan on the subject of feeding adult bass on liver, and what I intended to say was we had no success in feeding them on liver continuously. We do feed liver to the adult bass after the spawning season and feed it more or less all summer, but in the fall of the year we feed minnows, and again in the spring. We found when we fed them on liver the year round the eggs would all blast; and while we think it is all right to feed liver a part of the year we believe they need the flesh of fish in the fall and spring in our latitude in order to make them healthy and of good vitality.

Mr. Clark: I would like to ask if we are to take up the discussion of the bass question now or after all the papers are presented?

President: That is with the meeting. My own impression is that it would probably be better to read the papers first and then enter into a general discussion.

Mr. Clark: It is an important question to me because I am an infant in the bass business—I am just commencing—and there are some questions I want to ask. I have been in the business thirty odd years, but I am still a primary school man.

PROPAGATION OF LARGE-MOUTH BLACK BASS AT SAN MARCOS STATION.

BY J. L. LEARY.

Seven years ago when I was ordered to San Marcos, Texas, to superintend the construction of a bass station very little had been accomplished in the way of propagating the black bass. Dr. Henshall had published his book and named him the king of hard fighters, and Mr. W. F. Page, then superintendent of Neosho station, had written his pamphlet for the Fish Commission and had made a beginning in the propagation of bass, as had also Mr. J. J. Stranahan. In fact the five ponds first constructed at San Marcos station, if I have been rightly informed, were planned by Mr. Page, and were the first ponds of the station stocked with this fish. I had previously suggested and found them entirely too small for the work to be accomplished.

Having fished for many years in the Albemarle Sound of North Carolina, where this great inland body of water and its tributaries are the natural home of the large-mouth bass, I was not only well acquainted with their habits of spawning, but knew that the schools of young fish after hatching would seek the shallow flats covered with rush and other water plants to bask in the sunshine and prey on the myriads of insect life that are here produced.

I at once conceived the idea that to make a success of pond culture one must conform as closely to nature as possible, artificially constructing the ponds to resemble the natural haunts of the bass. Therefore I suggested that we build our ponds not less than one-half an acre, and while the ponds be made deep at the draw-off they have a large area of shallow water. My suggestions along this line were adopted and what success I have had is due to making my ponds conform as near to nature as possible.

Now as to stocking ponds with brood fish, the best method, if possible to do so, is to secure good native fish, selecting always the best. This I have done at San Marcos station; however, I have now a fair supply of my own raising. Since I have more pond room for the past three seasons I have carried over each

year about one hundred of my best and earliest fish. This selection of choice fish should be made in the spring, when it is possible to do so, and all poor fish liberated. I find fish weighing from two to three pounds preferable for brood purposes. During the winter all my ponds are laid bare and the accumulation of water plants, mosses, etc., taken out and hauled away, leaving the ponds exposed to the air for from six to ten weeks. My brood stock in the meantime are held in very small ponds built for nursery ponds and well fed until ponds are filled and ready to receive them. Then I plant twenty-four fish, twelve pair as near as can be selected, to the half acre of water. This, after experimenting, I have found to be about the right number to obtain good results. I wish it understood that I have no direct way to distinguish sex, except general appearances, but from the fact that our ponds produce thousands of fish it is quite evident that we get them stocked with a fair share of males and females. In spawning the bass follows its natural instincts and will nest on the banks of ponds in from twelve inches to three feet of water. I have, however, tried several kinds of artificial nests, the most successful being a wheelbarrow load of gravel placed around the ponds at intervals of from forty to fifty feet, near the banks and in a variety of depths of water. Many fish take to these gravel piles and they seem to be acceptable to the fish and answer the purpose for which they were designed. This gives each pair of fish plenty of room. Being thus isolated they disturb each other but little and only now and then do we see a fish that is scarred from fighting. My bass commence nesting from the 8th to 15th of February and now and then we have a nest late in June. This has occurred only two or three times in the past six years, and usually with very poor results. I further find that the great loss of young fish is just after hatching, say the first five or six days, before the school becomes active and just after the food sack is absorbed. After this period, provided the water is well supplied with food, the loss is small until the fish attain at least two inches in length and for this reason I never transfer to nursery or shipping ponds fish under one and one-half inches, then they can take food such as chopped fish and crawfish. This food is prepared in the following manner:

If fish, it is skinned and all large bones removed; if crawfish,

only the tails are used. This flesh is then placed on a chopping board and chopped very fine. Then it is run through a plate having perforations of 1-32 of an inch. This screening is then mixed with water to the consistency of cream and fed to the small fish. As they increase in size minnows, young carp, and mud shad (Dorosoma cepedianum). The fry of this latter fish is the finest food for young bass I know of and all pond cultural stations should have a pond provided to rear this class of young fish.

I give experiments made with young bass several years ago to determine the most suitable sizes to transfer from brood to nursery ponds and since then no fish have been transferred under one and one-fourth inches in length, they are then fish and can be held with some certainty of getting a fair per cent distributed.

First Experiment.—1,000 young bass one and one-half inches long were placed in a pool six by sixteen feet and one and one-half feet deep. At the end of one month the loss by death was 126, and by cannibalism 139, the greatest loss from death was during the first two weeks. The largest number that died any one day was twelve. These fish were fed on the flesh of perch prepared as above described.

Second Experiment.—1,000 fry just after food sack was absorbed were placed in a pool six by sixteen feet and one and one-half feet deep, supplied with small insects gathered in moss from river, and many water fleas (Daphnia). After the third day they commenced to die, the greatest loss was seventy-one in one day, and at the end of the month there remained, in round numbers, 200, and these were not in good condition.

Third Experiment.—1,500 young bass from two to two and one-half inches in length were placed in a section of pond sixteen by fifty feet. This pond had a fine growth of water plants (Myriophyllum) and in it were great quantities of insect life. These fish at the end of the month were in fine condition; 1,240 were shipped out and distributed. The result showed a loss of 260, and ten of these died from effects of handling during transferring. The 250 lost I attributed to cannibalism.

Fourth Experiment.—5,000 fry (number estimated) were placed in section of pond sixteen by sixty feet. At the end of one month 750 were found. This pond was well supplied with

water plants and apparently full of insect life. This was rather an extravagant experiment, but the result of the combined experiments shows conclusively that young black bass should not be transferred from brood ponds during the fry stage. During my feeding of the small fish I tried maggots which were readily taken.

When transferring young fish not only should great care be exercised but very soft material should be used in making the seine. I find bobbinet in every way satisfactory. I get two bolts, twelve yards to the bolt and three yards wide. This I rig into a seine nine by sixty feet. The twelve feet taken up gives plenty of bag. The top line is well supplied with floats and the bottom line quite heavily leaded to make it sink quickly. On the bottom line about six feet apart I place a cedar float one and one-fourth inches in diameter and five inches long. The purpose of this float on the bottom line is to keep the seine from rolling in ponds full of water plants. With this seine I can surround an entire school and in the bag of such a net very few fish can escape. We have landed as many as 6,000 at one haul.

These fish are placed in nursery pools and held for shipment. being fed as above described. Nothing but fish are distributed from San Marcos station, varying in size from two to six inches in length and the results from our plants have been satisfactory.

My black bass have done splendidly this season and I still adhere to my plan of plenty of room with an abundance of food if one wishes to be successful with the black bass.

DISCUSSION OF MR. LEARY'S PAPER.

At the beginning of the paper Mr. Leary said: I speak of the Fish Commission because I do not know of any others that had commenced the propagation of black bass before that time.

I can further state that the brood stock should be well fed after the season of spawning up to the time they commence to spawn again. I believe we get healthier eggs and better fry in that way. You keep your fish in fine condition during the entire season after spawning. (Applause).

Mt. Atkins: Do you feed during the spawning season?

Mr. Leary: Occasionally I do, about once a week during the spawning season.

Mr. Atkins: How often in other parts of the year?

Mr. Leary: I feed usually twice a week.

Q. Do you think they require less during the spawning season

A. I do. Proof of that is that during the spawning season bass are hard to catch even with the most tempting bait.

Mr. Atkins: I have an idea that possibly it might be worth while to withhold food entirely from them at that season.

Mr. Leary: Possibly it might, but the bass that are not nesting want a little feeding, and those are the fellows that get it.

Mr. Titcomb: What is the length of your spawning season?

Mr. Leary: From about the 8th of February until June—occasionally, as I say, we find a nest in June, but the larger number of nests have always been found in the month of April.

Mr. Titcomb: Wont you explain about the food which you collected for your young fish?

Mr. Leary: The crawfish we collect by seining the pools and an adjoining creek known as Purgatory, and we have secured as many as a barrel at a time, and we carry them home and store them in one of our nursery pools, keep them alive, and all the dead fish we have at that time, or left over from feeding the bass from the Blanco river, mud shad and mullet, we throw in to the crawfish. In feeding we break the tails off the crawfish, skin them and prepare them by chopping very fine and screening, feeding only the tails to the young fish, and the residue of the fish we throw in to the old bass, which they readily take.

Mr. Titcomb: Don't you also collect a lot of small snails?

Mr. Leary: No, because we have an abundance of snails in the ponds—especially at this season of the year when they are throwing off spat and little particles of jelly-like stuff which the fish like, but I do take from the holes of the Blanco river that I can seine, a mud shad, and sucking mullet, we call them down there, I take them home and chop them up. I skin and take the bones out of all the fish that I chop and feed to my fingerling bass.

Mr. Titcomb: You don't cook any food for your fish?

Mr. Leary: I do not. I tried liver and they do not take it readily—of course we want to give them what they like most.

Mr. Titcomb: Did you ever try mush and crawfish mixed?

Mr. Leary: I am of the opinion that mush in any form is not good for bass, in fact they will not take it.

General Bryant: Your fish feed the year around?

Mr. Leary: Yes—it is warm the year round.

Mr. Beeman: What method do you have in handling your fry?

Mr. Leary: I do not handle any because I have had such poor luck in transferring fry that I let them alone until they are about three-fourths to an inch and a quarter long. If fry is going to be handled at all they must be taken from the pond as soon as they rise before the food sac is absorbed, and planted, and if it is suitable water a fair per cent may live.

Mr. Beeman: How do you get them away from the old fish after they are hatched?

Mr. Leary: It is a very easy matter to take a school of young fish, because they school in a body before and after the sac is absorbed.

Mr. Beeman: Do you allow the old fish and young to remain in the same pond together?

Mr. Leary: Up to the time they are three-fourths of an inch long—up to that time the parent fish take care of them.

Mr. E. N. Carter: Do you have any trouble from young bass getting down in the moss?

Mr. Leary: We have a few bass in St. Johnsbury that dive down to the moss, but after using the seine several times the moss will be rolled smooth.

Mr. Carter: Don't you kill any young bass in that way?

Mr. Leary: Very few.

Mr. Carter: How long is the moss?

Mr. Leary: Our moss grows any length there. If the pond is fifteen feet deep it will reach the top. Of course you don't seine the bottom, but your fish after they get to be an inch or three-fourths will school for the top—on a bright sunshiny day after 11 o'clock they will school at the top.

Mr. Lydell: Are these rollers you used, wooden rollers?

Mr. Leary: They are such as are used on net lines.

Mr. Lydell: Then you have to provide lead enough to sink the rollers?

Mr. Leary: Yes, but the roller sinks readily. At the same time it lifts the net least bit when it strikes anything.

Mr. Lydell: We use an iron ring about eight to ten inches in diameter, and attach one about every four feet to the lead line— it answers the same purpose and acts as a sinker at the same time, and our lines do not roll at all.

Mr. Leary: I got a gentleman who owned a muddy cattle tank to allow me to put crappy in there with the privilege of having part of the game fish. I sent out to seine the pond, and they said the pond was so full of mud they could not get the fish. I said I would go out the next day and I could catch the fish. They did not think I could do it; I said "I will show you;" I said "get me a few empty beer bottles"—not full bottles you know—I dare not take a full bottle of beer. (Laughter). I got these bottles, put corks in and tied them at intervals.

Mr. Lydell: Would you not have caught more fish if there had been something in the bottles? (Laughter).

Mr. Leary: I expect I would—I just tied those beer bottles at intervals along that bottom line and got plenty of fish.

Mr. Clark: The last papers are certainly very interesting, and this is a subject that has interested me very much, as I am seeking information on the bass question. We have at Northville a natural place for bass ponds, and we can make any number of nice bass ponds in connection with our trout work. Mr. Bower and Mr. Lydell both say that nature has done for us what they have hunted for nearly a year to find. Some few months ago, or in the winter perhaps, I received instructions from my chief in Washington to prepare for the culture of bass, and was asked to suggest plans for the ponds. I made same sort of sketches and they were forwarded to Washington, and the architect and engineer prepared plans which were forwarded to me to work upon in the building the ponds. You have been talking about the food and the size of your bass, and what you are going to distribute, etc., and I am not up to that, although I might say in passing, I did hatch bass fifteen or twenty years ago, just hatched a few, but not to make a business of it; so that I do not claim to be a bass man at all, and I am an infant in the matter. Now the question that I want to know is, are your bass ponds right? Is the bass pond at Mill Creek where Mr. Lydell and Mr.

Bower are, right; are the ponds at Neosho right, and all these ponds that have been made? Before I undertake this work for the United States Fish Commission I want to know that what I am going to build is the best up to that date. You have got your ponds all built; I am just commencing, and I want to profit by any experience that you may have. Some say they want to be so deep in such a part, and the spawning area wants to be so deep. Now the question I want to get at is, what is right. I can make those ponds practically any depth from one foot to fifteen; now do I want fifteen feet of water, eight feet or six or four for those fish after they come down off the spawning area? And do I want forty or fifty feet of spawning area on the sides of the pond, or do I want less or more? I have the plans here as they are drawn up. I want to have those things fixed right so that I can build at Northville up to date bass ponds. If you people know of something better that you have got, suggest it, and I will have it prepared. I have got five ponds drawn out here on these plans, and those provide, as they were drawn up by the architect and engineer, for a certain depth—of course nothing definite—but I presume drawn something after the style of the San Marcos or possibly the Neosho ponds. But of course they knew nothing about the Mill Creek Hatchery or the Michigan State Commission.

Now this plan provides for a depth of from nothing to two and one-half to three feet in the spawning area, and not to exceed five feet, I think it is, in the deepest part. Now the question arises, is five feet deep enough?

Mr. Leary: Not in your climate.

Mr. Clark: What is the depth of your pond in what we call the "kettle?"

Mr. Leary: In your climate it would have to be deep. My climate is warm and we have no ice. I have one pond of an acre and a quarter nine feet deep at the drawoff, and it goes to nothing. The shallowest point at the drawoff of any of my ponds is five feet.

Mr. Clark: That is in some other pond?

Mr. Leary: Yes, the largest pond I have is nine feet deep at the drawoff; 100 feet from there it is six feet, 100 feet further

it is four feet, and 100 feet further it is nothing. At the point last mentioned is my inlet pipe.

Mr. Clark: The point I wish to raise is this: If you could have any depth you want, which I can, up to fifteen feet, what would you make the depth of this kettle?

Mr. Leary: I would make the depth of that kettle as great as I could in your climate, providing that I could draw the water out of that pond. If you can make it ten or fifteen feet and draw the water off, make it so; but you want to have your ponds so that you can draw them off and clean them.

Mr. Clark: The forty feet of spawning area you would have from three feet to nothing.

Mr. Leary: Yes, sir.

Mr. Titcomb: Forty feet margin?

Mr. Leary: Yes, more if you want to. The center of this pond runs down from six feet then to four feet and nothing and comes off either way to nothing. The object of having all that shallow water is that it warms up early in the season and produces a large amount of insect life that the bass feed on, and it produces an early growth of plants, providing shelter and feeding grounds for the fry.

Mr. Clark: I would like to ask the other bass men if what Mr. Leary has said they concur in, especially as to the depths?

Dr. Henshall: I would not recommend anything more than twelve feet in your climate.

Mr. Clark: I will take care of the climate.

Mr. Leary: I think you want more than ten or twelve feet for hibernation.

Mr. Clark: Do we want a good depth of water, or comparatively shallow water, for the bass? The climate is another question. We know what we have to provide for, and the question is, how much depth of water do they require?

Dr. Henshall: Not less than twelve feet.

Mr. Clark: Is that the general opinion of the bass men here?

Mr. Lydell: I am not prepared to state, because we have not a pond with more than six feet of water in it; but we are getting good results from it, and we are further north than Northville. I think ten or twelve feet will do all right; but our

pond is only six feet deep, and when we draw it down as low as possible we still have two feet left. We cannot draw the water out of our ponds, because we have not the drainage, and when we draw them that way we seine off everything; and I think perhaps it is beneficial in one way: we do not run all the food out our ponds. When we draw a pond down the food is still in there, and then we seine out every minnow; and I do not know but what it is well to leave some water in the pond—although I have not any pond that I can draw clear down; but I know by not drawing them clear down we have lots of vegetation left, and it starts up quicker than it otherwise would.

Mr. Clark: I do not think there is any question but what Mr. Lydell would, if he could, have every pond so that he could draw every drop of water out, not that perhaps he would want to do it every winter, as Mr. Leary does, but it is preferable to have the pond so that you can draw the water all out for repairs or otherwise.

But the main point it seems to me in regard to this matter is, what is the depth—should the bass have fifteen or six feet. Now would Mr. Lydell, if he could, have twelve to fifteen feet of water in his pond?

Mr. Lydell: Yes, sir.

Mr. Clark: Would Mr. Dean?

Mr. Dean: Yes, sir.

Mr. Clark (to Mr. Beeman): What would you say?

Mr. Beeman: Our ponds have a depth of eight feet over the kettle, and they worked very successfully last winter.

Mr. Clark: Would you have it deeper if you could?

Mr. Beeman: I do not see any absolute need for it.

Mr. Lydell: Do you think the depth of the pond has anything to do with the successful propagation of bass?

Mr. Leary: No, except you want to keep the water from freezing at the bottom; and in a warm climate to have no dead water for big fish to go in. You can have it three feet or 100 feet deep if you can draw the ponds off, but it is necessary to draw them off and get everything out of them. Climatic conditions must be taken into consideration. Aquatic plants grow very profusely wth me, but not so with you, but you can have the water any depth you please, provided you can draw your

ponds off and have depth enough to protect from extreme heat and cold.

Mr. Clark: Then I understand that even with the large-mouth bass you would prefer to have the water deep enough so that it will be cool for those fish?

Mr. Leary: Yes, sir, so that they can resort to it occasionally.

Mr. Clark: Most of you people have been handling the large-mouth bass. My instructions from Washington are that I am to handle no large-mouth bass whatever, but all small-mouth, and I have to prepare for the handling, catching and distribution of the small-mouth bass exclusively. Now naturally we have got to the right ground—we have got something perhaps that none of you have. Into every one of those ponds after they are completed I will have my creek water running with a summer temperature of 75° to 80° F., and by turning a valve I can turn in spring water at a temperature of 53° into any pond; and in case the river water is roily at spawning time, I can shut off the creek water, turn the valve from the spring water and put in what is necessary to tide the fish over.

Mr. Leary: You have an ideal location.

Mr. Clark: That is what they tell me, that it is an ideal place, so far as that is concerned; but before making the mistakes that you people have all made, I want to be started right I have made mistakes in fish culture, gentlemen, and many of you are today profiting by the mistakes I have made (laughter), and I propose to step in and profit by the mistakes you have made.

Mr. Waterhouse: I think natural conditions should be imitated as closely as possible. I have discovered no good bass ponds where there is good fishing, where there is not good depth of water, ten or twelve feet at least in the deeper parts, for hibernation, and plenty of shore water besides for spawning purposes, and furnishing a good growth of plant life, and it seems to me in every case where I have had good fishing I had to get a good depth of water—that is a natural condition.

Mr. Beeman: I would like to inquire what the temperature of that spring water is which you propose to supply your pond with in case of roily water?

Mr. Clark: I do not propose to give the bass a temperature of 53° when spawning; but the idea of spring water is to have clear water and perhaps to put in enough of the spring water to take care of the fish, but not to lower the temperature of the water too much; the temperature of the spring water is 50°.

Mr. Beeman: My impression was you intended to close off your main supply and turn in spring water in case of disturbances?

Mr. Clark: Yes, in case of roily water—that I would lower the temperature of the water and destroy the eggs—is that what you are getting at?

Mr. Beeman: Yes.

Mr. Clark: I would not do that.

Mr. Beeman: In case you had a storm of three or four days' duration, would not the spring water lower the temperature of those waters to the danger point?

Mr. Clark: You will notice that the ponds are so arranged that I can, if necessary, obviate any such difficulty as that. The spring water will be put into one pond and that will be exposed of course to the sun and the warm air, and if the worst comes to worse I would only lose perhaps a little in this particular pond where they had spawned. Then the water would go into the other pond at a warmer temperature, probably 70° F. I would not put in a sufficiently large quantity to cool the whole thing—in fact I could not do that—I have not enough spring water. So that the matter of regulating the temperature there I can handle all right, and I can give them clear water. There is no reason why when these ponds are completed there should ever be any roily water in them, if we do not want it there.

Mr. Beeman: The reason I made this inquiry is, I had a little experience at our pond this summer. We were troubled some with roily water there, and in attempting to get around that we shut down entirely. Our ponds were so constructed that I was able to run about four hours with very little fall of surface water, but that was not long enough to prevent roily water coming in; because we had a storm of three or four days' duration. During that time our bass all spawned for the third time and we lost all the eggs, the temperature of the water falling to 59°. Now the air temperature a good deal of the time is about 50°, so

you could not depend upon the air temperature keeping the temperature of your ponds up to 70°. If your air temperature is low the temperature of your water would fall.

Mr. Clark: Certainly—if we have a snow storm in June or July up in our country, why, we do not expect to keep a high temperature.

Mr. Beeman: Those conditions did not quite prevail at our hatchery, but I was informed that they did have snow in Boston at that time. But it is possible to have a week's storm where the air temperature would be from 50° to 60°. Under such circumstances the spring water would reduce the temperature of the ponds to a danger point, and that is the point I desire to get at.

Mr. Seymour Bower: I think Mr. Clark's idea is to admit just sufficient water to hold the pond up, merely to offset evaporation. In warm weather the pond exposure will maintain the temperature; it will go down in cold weather, of course. The idea of admitting spring water is merely to maintain the level of the ponds. If the weather is warm you can use the spring all right.

Mr. Clark: I wish to state right here that this idea of the spring water is not original with me—I got this from Mr. Lydell—I do not want to steal some other man's thunder. When I visited Mr. Lydell's place he told Mr. Bower and Mr. Bower told me the same thing, that if they only had sufficient spring water there they would be all right; that if they could turn in spring water to these ponds, in some of these roily times it would help them out; and when they went to my place I showed them what I could do and they said, "do it by all means," and that is where I got my idea of having the spring water piped over there. It may lie there two or three years and never be used to any great extent, but when I have it there it will hold the levels up, and there will be no trouble during a storm of two or three days. How convenient it will be to put on just a little water to keep your pond water going along in just the same condition! Of course if the temperature goes down we cannot help it.

Mr. Lydell: As I understand it, these gentlemen are breeding large-mouth bass, and as Mr. Clark has been instructed to breed only small-mouth bass, he will find he has a different prop-

osition, and will have plenty of chance for experimenting. I do not find any trouble in breeding the large-mouth bass, but the small-mouth bass I find afford considerable opportunity for experimenting; it is not perfected by any means, and Mr. Clark will find that the conditions in his locality will be different than they are at Mill Creek, and he has got to work the problem out for himself, because the conditions are different where he is and where we are.

Mr. Titcomb: I am going to suggest this, inasmuch as Mr. Clark has five ponds to build, that he try all the depths from six up to fifteen feet, say six, ten, twelve and fifteen, or eight, ten, twelve and fifteen, and see what his results are, and then we will have an actual experiment on different depths.

Mr. Clark: That is a good idea; and if a deep pond was found to be preferable, the other ponds could be very easily deepened.

Dr. Henshall: The deep pond is not so sensitive to changes of temperature as a shallow pond, and therefore I should think the deep pond would be better.

Mr. Clark: I have the information I came here for, and that is a general idea of the depth of the pond. I might say that there was a little question of difference in this matter between myself and the Washington people, and we thought it was better to see what the bass people said at this meeting, and I am well satisfied that the general idea is, as far as you have gone, that the deeper the ponds are, the better, but the suggestion of Mr. Titcomb of course, is something which would afford some distinct advantages, and we shall take it up.

Mr. Titcomb: I want to get from Mr. Beeman an account of his work. He has been doing some work with small-mouth black bass, and from what conversation I have had with him I should say that he has learned a good deal about their habits, and I think we can get some valuable information from him.

Mr. Beeman: I came here with the intention of listening, not of saying anything. In fact I do not think it is just my forte to address a meeting, but if there is anything that I can offer of benefit to the Society I shall be pleased to give it. I have had some correspondence with some of the gentlemen here and conversation with them in regard to the amount of bass we pro-

duced. At the time I removed the fry from the spawning boxes I had no time to count them. The only way that I could get at the number was to transfer them to a tank that I had built at the north end of the hatchery, and after the first hatch were placed in this tank I had several persons who came there give me what in their opinion was the space occupied by a single fish. The distance was placed at about one cubic inch. After figuring up the capacity of this tank I was somewhat surprised at the result: it gave me 414,720 cubic inches, which, according to the calculations would give the number of small-mouth bass fry that I had on hand. Since talking with some gentlemen here they think it is an utter impossibility, as I had only twenty-four breeding fish in my pond at that time; about one-third of them were males, the other two-thirds were females; but I do not wish to make this statement as absolute—I cannot say that it is the exact number of fish, because undoubtedly it is not; but it gave me some idea of what we might have.

Mr. Clark: These were all small-mouth bass?

Mr. Beeman: Yes.

Mr. Lydell: What size were they?

Mr. Beeman: At that time those that I retained in the nursery ponds were one and one-eighth to two inches in length.

Mr. Clark: I mean adults.

Mr. Beeman: They ranged from one and one-half to four pounds each. The females were the largest. Most of my females were from two and one-half to three and one-half pounds—one or two specimens were nearly four.

Mr. Lydell: We made an accurate count of the roe in a female small-mouth bass weighing one and three-fourths pounds at Mill Creek station this year, and there were 5,000 and some odd eggs in the fish. They were counted by Professor Reighard and myself.

Mr. Beeman: Probably the calculation I have given is not exactly correct; it may be overestimated, but when the bass spawned the second time I counted up the results of one nest, and it produced 6,210 fry; this was a second spawning and there were nowhere near the number of eggs deposited at the second spawning that there were at the first. In fact I observed four cases in the first spawning, where two females spawned in the

same nest with the same male, the second female entering the nest inside of twenty-four hours after the first female, and her eggs were deposited apparently right on top of the first eggs.

Mr. Clark: What do you mean by first and second spawning?

Mr. Beeman: I mean after the male bass had cleaned up the gravel in his nest and selected a mate and this pair had gone in, and the female had spawned, she left, and the male remained on the nest, and inside of twenty-four hours I observed another different female was there with this male bass and spawned there. Four instances of this kind I observed at our hatchery this year.

Mr. Lydell: I found the same condition in the large-mouth bass this year. We had two lots of eggs, one lot hatched and there were three or four days before the other came off, and you could distinguish the difference between the two schools of fry.

Mr. Beeman: There was no distinction between the size of the fry, because the eggs were deposited within twenty-four hours of each other, and when the fry rose from those boxes it was a sight to behold. They were so thick you could not see the gravel in the bottom of the boxes.

Mr. Leary: Don't you think it was the same female?

Mr. Beeman: No, sir, there was such a wide difference in size it was easy to distinguish. I am certain that they were different females for that reason.

Mr. Lydell: You are certain that the first lot of eggs laid were not disturbed?

Mr. Beeman: They were not disturbed.

Mr. Lydell: I have had them this year lay one lot of eggs and the male would immediately destroy the eggs, and there would be another spawning with another female, and on examination the eggs were found to be bad.

Mr. Beeman: We had the same fish spawn the third time.

Mr. Titcomb: How long a period was covered by the spawning season from the first fish which spawned to the last one?

Mr. Beeman: The first bed to be taken and spawned on was May 10th, on Sunday morning. Now these are notes that I took, and I have not had an opportunity to refer to them—I just kept a diary noting down some of the interesting things I ob-

served there. I think it was about four days from the time the first bass spawned until the first spawning was completed.

Mr. Lydell: No bass spawned after that time?

Mr. Beeman: No, sir, not during the first spawning.

Mr. Titcomb: What was the total period?

Mr. Beeman: In the temperature of the water there the eggs apparently hatched in between four and five days. The temperature when the first eggs were deposited was 64° F.

Mr. Titcomb: What is the period covered by the three spawnings?

Mr. Beeman: I will look it up.

Secretary: Have you distributed any black bass?

Mr. Beeman: In our lake, yes.

Secretary: About how many have you distributed in your lake?

Mr. Beeman: I distributed the entire two hatches with the exception of about 16,000 which I retained in the hatchery, attempting to raise them up to fingerlings. I held these fry in a tank and supplied them with small crustacea for a week; I planted them after they were removed about a week from the spawning boxes. The second hatching I held in the tank for two weeks and they about doubled their size fed on the crustacea. At that time the crustacea coming in from the river began to fail, and as I had overstocked my nursery pond, having more small bass there than the natural food supply would raise, I was obliged to clean the second crop out of the tank and put them in the lake. About two weeks ago I found the demand in our ponds so great I could not get crustacea enough, so I took out 6,000 an inch and a half long and planted them in the lake—this reduced the number in the nursery ponds so I could keep up with their demands for the crustacea.

Mr. Titcomb: How did you collect crustacea?

Mr. Beeman: I used a net made of cheese-cloth placed on an iron frame three feet square, and these nets were placed in the river where there was a gentle current, which drew the cyclops and daphnia into these nets. They were allowed to remain there for a space of five or ten minutes, and then they were taken out, and as they were drawn out then I reversed the nets and rinsed them off in a tub which contained water, and that

removed the small crustacea from the nets. After repeating that operation five or six times I would have sufficient crustacea to take to the hatchery.

Mr. Lydell: How many of these fry did you distribute altogether?

Mr. Beeman: The way I base my calculation, 426,000, but it may be overestimated.

Mr. Nevin: Did these same bass spawn three different times in succession?

Mr. Beeman: Yes, there were no other bass in the pond and we had three different spawnings two or three weeks apart. The second spawning took place almost immediately after the fry from first spawning was cleared up.

Mr. Ravenel: Did you keep a record of the total number of nests at any one time?

Mr. Beeman: During the first spawning nine boxes were spawned in; three of those boxes were lost; consequently there were only six productive boxes.

Mr. Ravenel: In the second spawning how many boxes were there?

Mr. Beeman: In the second spawning there were I think eight boxes, and five were productive.

Mr. Ravenel: How was it with the third spawning?

Mr. Beeman: The second spawning was much smaller than the first, very few eggs deposited compared with the first spawning. In the third spawning eight boxes were spawned in, six almost at one time. After three days' duration one male deserted its nest and went immediately to another nest near by, made up his nest and selected a female and she spawned again in that nest. The next day another male deserted his nest and went to another box and spawned there with another female, but at the end of three days' time, after the eggs were deposited, all of the males deserted their nests and the third spawning was a total loss.

Mr. Ravenel: You had a total of twenty-four nests occupied during the three spawnings?

Mr. Beeman: Yes, sir.

Mr. Lydell: I think this second and third spawning is interesting. In the first spawning I have known of two males

using one female. Professor Reighard and myself this year watched the fish. A pair of bass was in a bed spawning and we watched them. He got half through, got a nice lot of eggs, and another male came in and he had a scrap with the gentleman and took the female away from him and took her to another nest and spawned with her there. There were two nests of eggs from one female.

In our experimental station near Grand Rapids when we first started, our superintendent sent me there, and we had in that pond thirty-eight or forty fish, and there were nineteen nests made that were productive, and I cleaned them up, shipped the eggs and took up my apparatus and went to Detroit, and about a week after that Superintendent Bower ordered me back to the station, saying that the bass were spawning again, and I got nineteen more nests that were productive, and shipped those.

Mr. Leary: I wrote Mr. Ravenel that I had bass that spawned twice and he said that it could not be possible. I told him it was possible because I had a blind bass among the fish, and she was the only one I had that was blind, and I know that bass spawned twice.

Mr. Titcomb: Was that a female or a male?

Mr. Waterhouse: Was the fry blind? (Laughter).

Mr. Leary: I cannot tell the difference positively.

Mr. Ravenel: The reason I made the inquiry from Mr. Beeman was because the question has been discussed a great deal and it is believed that they spawned twice. Except the case referred to by Mr. Leary, which I regard as authentic, we never have had any definite proof that bass spawned twice. I wanted to prove whether he had a sufficient number of nests at different periods to indicate that the bass had actually spawned more than once.

Mr. Lydell: I know the male bass will spawn twice. I think the blind bass the gentleman speaks of was excusable, for he could not see what he was doing anyhow. (Laughter).

Secretary: I would like to ask Mr. Beeman how many fry he has planted and how many fingerlings, and how many he has on hand.

Mr. Beeman: I planted all of the fry produced there except about 16,000, as near as I could estimate it, which were put into

the nursery ponds. About two weeks ago I took from those nursery ponds about 6,000 of the fish there, then an inch and a half long, and planted them in the lake. I did this to reduce the number, because I was unable to get crustacea enough to feed them at that time so that they would thrive. I have about 10,000 there at the present time.

Secretary: These are small-mouth bass?

Mr. Beeman: Yes, they are all small-mouth bass.

Secretary: Then you have had considerable success in raising small-mouth bass?

Mr. Beeman: It would seem so thus far.

Mr. Lydell: What is the source of your water supply?

Mr. Beeman: At present from our mill-dam 1,700 feet from Lake Waramoug. The original design was to get our supply from the lake far enough from the shore to avoid disturbances, but the lake was so high last fall we could not accomplish it. So we stopped our pipe about half way to the lake in our mill-dam, which takes its supply of water directly from the lake; so that we are practically getting the same water we would get from the lake, except we get some roily disturbances in time of storm.

Mr. Lydell: What designs of beds are you using?

Mr. Beeman: Acting on the suggestion in Mr. Lydell's paper read at Put-inBay, I am using a nest box enclosed on three sides. Near the surface and extending down about four inches is an opening all around this box which is enclosed with fine wire netting, which gives a little circulation of water through the top of the box. The fourth or open side is so arranged that I can slide a screen in there. When the fry are ready to arise I slip this screen in place and corral them right in this box. The only objection I have found to the box is that the water is liable to become stagnant or get a little thick there.

Mr. Lydell: Did the fish show the result of the stagnant water?

Mr. Beeman: They did. The fish began to suffer a little, coming to the surface and gasping.

Mr. Lydell: Were they suffering from hunger or stagnant water?

Mr. Beeman: I should judge from the closeness of the water in the box, for the reason that after bailing from the outside sev-

eral pails full of water which when poured into the box cleared up the water, they were all right, and showed no signs of distress.

Mr. Lydell: You ought to have that little stream from Mill Creek running into these boxes. (Laughter).

Mr. Clark: I would like to ask if your screen was all around this box, why you did not keep the screen clean, then you will have your circulation of water all right.

Mr. Beeman: I used the common wire mosquito netting for a screen, and yet the little bass would go through it; it is not fine enough, and the moment I cleaned up the screen some of the bass would escape.

Mr. Nevin: Cheesecloth will answer the purpose.

Mr. Beeman: I used that on the front. An improvement suggested itself to me in this manner. On the side opposite the open side I would suggest someone try leaving an opening there of a foot in width extending from the top to the bottom of the box, or down to the gravel, and during the time that the eggs are deposited and the parent fish caring for them, I would slide a board in that place instead of a screen, and just before the fry rise I would remove the board and put in a screen there. Also the screen in front of the box. This would give a little circulation of water through the box.

Mr. Clark: That is a good idea, but I cannot conceive why your wire around here, being put there for the purpose of giving you a circulation of water, should not be kept clean.

Mr. Beeman: That would be all right if the wire netting is fine enough. Another point: this wire was placed from the surface of water down about four inches. The rest of the way down it was enclosed with boards perfectly tight. So, while the water might circulate a little at the top of the box it remained somewhat stagnant at the bottom.

Mr. Nevins: Put your wire netting down within a foot of the bottom.

Mr. Beeman: The idea in constructing a box on three sides is, to give the fish ample protection, and furthermore to handle the fry after they rise, because the school quickly scatter and it is hard to capture them. So that you have got it in a nutshell; if you have the boxes so that you can screen them in. You have

only to supply a perfect circulation; I accomplished that by dipping a little water from outside and pouring it in, and it worked all right. If you intend to breed the small-mouth bass I suggest that you have on your spawning shoals even depth of two feet, because if you build these boxes perhaps two feet seven or eight inches high, they may not hold your fry when they rise. The top of these boxes must project above the water, otherwise the fry will come right over the top.

Secretary: This discussion it seems to me has a great deal of interest, because Mr. Beeman is purely an amateur who took up this matter quite recently. He resides on Lake Waramoug, Conn., from which bass were nearly exhausted, and he and others living on the lake wanted to restore the supply, and they started in in an amateur way to raise bass, and he got his information through the men of this Society who have experimented in this line. I think he corresponded with Mr. Lydell, Mr. Titcomb, and different men of the Society whose names he gathered from the reports of our proceedings; and therefore he is an amateur and goes into the work without any prejudices or preconceived opinions; and I think his experience and his opinions are very refreshing on that account, because he has not made a lot of mistakes heretofore. What he makes now he is free and frank to acknowledge, and he may have discovered something, and I rather think that he has succeeded in raising small-mouth bass in quantities which it has been stated is an almost unknown thing as yet. I believe Mr. Lydell has said that the raising of small-mouth bass has not been very successful.

Mr. Lydell: Not so bad as that. (Laughter).

Mr. Beeman: I would like to acknowledge my indebtedness to Mr. Seymour Bower of Michigan who gave me valuable information as regards the construction of the pond, and also to Mr. Lydell, but at that time Mr. Bower did not give me very much information on how to handle the bass. He said that there was little known on the subject.

Mr. Bower: You will remember you agreed to visit our Mill Creek station last season, and I said I would give you all the information I could, but you did not show up. (Laughter).

Mr. Beeman: The reason is that I was too busy at home with our own hatchery. We commenced the work a year ago

this last spring and did not complete the ponds entirely; but we got them far enough along so that we collected our bass and wintered them in the ponds. They were caught with the hook and line in the different lakes last fall, with the exception of ten that I took through the ice early in March. In the spring following there was a lot of unfinished work to do, and I began at it immediately, as soon as the season would allow me to do so, we finished up the work around the pond on a Saturday night, and just about daylight on Sunday morning the bass began to spawn, so you see we did not lose very much time.

In addition to the work of constructing the ponds I have had to make all the paraphernalia in connection with it myself, and tend to the fish. Up to the present time I have done all of this with only the assistance for the last two weeks of my son, since the bass began to spawn.

Mr. Lydell: I will bet you did not work over eight hours a day.

Mr. Beeman: While I handled this vast amount of fry my work has averaged fourteen to twenty-one hours a day. In the first hatching and transferring I was obliged to use cheesecloth to strain the water at outlet of tank, and in collecting the crustacea I got some sediment in the water which clogged the screens, and I found that the tank would overflow every two or three hours, and I was obliged to stay up all night and watch the tank. But the idea suggested itself to me after losing two or three nights sleep, of using a screen of very fine wire cloth, and feeding my fry through the day with crustacea, and just at the close of the work I slipped in the wire screens and shut down a part of the water supply. I was running a supply from a two-inch pipe with a fall of fifteen inches, and the fry would drift up against the screen during the night, and this current of water was sufficient to draw them from the bottom up against the screens; but by closing down one-half of the supply, the current was regulated, so that I did not have any further trouble, and I put in the wirecloth screens and went to bed.

Mr. Clark: What is the depth of your tank?

Mr. Beeman: The tank itself is about three feet deep, and contains two and one-half feet of water.

Mr. Clark: What is its width?

Mr. Beeman: Its width is six feet and length sixteen inches.

Mr. Clark: And did you have a screen right straight across it?

Mr. Beeman: No, in two divisions on the lower end.

Mr. Clark: Did you have just a straight plain screen too?

Mr. Beeman: I had a frame in the wall: The tank was constructed of cement and stone. I had a frame in the wall about twenty inches square, and two screen frames on the six foot end of the tank.

Mr. Clark: I will show you how to build a screen that wont clog up unless your water is roily.

Mr. Beeman: This wire answered the purpose all right.

General Bryant: What was the entire length of time of the spawning season from the first to the last spawning?

Mr. Beeman: I attempted to look that up, but my memoranda are not very clear. In the first spawning the eggs were deposited May 10th, and those three spawnings occupied a period of seven weeks. It was my intention and desire not to say anything before the meeting at this time, but I was drawn into it. I intended to make a very close observation of the habits of the bass another year, get down some fine points, and perhaps write a paper then on the subject, get all this data together, and sift out the worthless and get in the valuable.

Mr. Titcomb: We hope you will do that.

Mr. Beeman: There is one interesting thing that I would like to investigate, and that is the development of the egg. We lost a lot of our eggs this year, and the only reason I can assign for it is the low temperature. The water fell to 59°. Will that temperature kill bass eggs?

Mr. Lydell: I have had 58° kill them—they died anyhow.

Mr. Beeman: One of the investigations I wish to pursue next summer is to take one nest of eggs and with a microscope make an examination of them as soon as they are deposited, to see if I can discover the germ, and how it appears when the egg is first impregnated. Possibly an observation of once a day until the eggs are hatched would give one a pretty clear idea of how a fertile egg appeared, and by examining a nest that failed you might get some idea of how you lost the eggs.

Mr. Titcomb: You can tell when your eggs are eyed.

Mr. Beeman: The bass all deserted the nests within three days' time after the eggs were deposited. Now the question is, were the eggs fertile, or had they never been fertilized. I made some examination with a microscope of some just deposited, some two days old, some three days old, but I failed to discover any germs in them, although the size of the egg makes it difficult to get a clear vision of it through a powerful microscope.

Mr. Nevin: Did your bass hatch in six days in a temperature of 60°?

Mr. Beeman: No, between four and five days, and not in a temperature of 60°; they did not spawn until 64°, and at the time the bass hatched the temperature was nearly 70°, it was beautiful weather, clear every day, and I could observe everything that took place through two of the spawning periods.

Mr. Seymour Bower: I do not want to discourage Mr. Beeman or anybody else engaged in the propagation of small-mouth bass, but speaking of raising bass from the standpoint of an amateur leads me to say this, that some six or seven years ago when we started out in the Fish Commission purely as amateurs, we had the best success in proportion to the number of adult fish in our stock ponds that we have ever had, and it was almost wholly guesswork. It was probably pure luck—I do not know what else to call it. Since then we have not had as large a proportion of beds that were productive in any one season—of course we have hatched a great many more bass, but in proportion to the number of fish, stock fish, we have never equaled our first season.

To determine whether the eggs are fertilized or unfertilized this present season we have employed Professor Reighard at our Mill Creek bass station; he is recognized as one of the most eminent zoologists in this country, and he has been there ever since the beginning of the spawning season, and is there at the present time. I asked him how he accounted for it that so many beds were non-productive, and whether he considered the eggs were fertilized or not, and he said, so far as he has been able to determine, that the eggs were fertilized, and that he could not account for the fact of their not hatching in any other way, except that there was a lack of vitality, either in the parent fish or in the eggs themselves. There was not sufficient vitality

to carry them through to the hatching point, but so far as he had examined the spawn, and he had examined a great many eggs from non-productive beds, he had found them all fertilized, and I thing Professor Reighard would not make that statement unless he was certain of it, because my experience is that scientists are very careful about making any statements that they may have later to take back.

Mr. Beeman: It occurred to me that there were three conditions, as you say, that might cause failure, first, bad weather, and second, low temperature of the water, and third, that in the third spawning the bass lose some of their vitality. If there had been a continuance of the nice weather and the second hatching had produced well and the third failed, you might suppose that it was owing to the reduced condition of the fish, through long continued spawning efforts.

Mr. Bower: Speaking about the bass spawning twice, I do not think the point is established that the female will spawn at two different intervals. I think it is settled that the male bass will officiate on several occasions; in fact he is almost human in that respect, I guess (laughter), but in the single case that Mr. Leary speaks of, of the blind female, I would like to ask him how long the spawning intervals were.

Mr. Leary: It was several weeks. She spawned on the same nest, but it was after the first spawning was hatched entirely and carried over.

Mr. Bower: Are you sure the blind fish was a female fish?

Mr. Leary: I am almost positive.

Mr. Bower: It seems to me that is quite impossible—in fact we know that the female bass will sometimes spawn on two nests, but the one spawning follows the other almost immediately.

Mr. Beeman: I have noticed it on several occasions during that season and since then.

Mr. Bower: Mr. Beeman speaks of the second and third spawning; I want to inquire whether he refers to the male or female fish or both?

Mr. Beeman: The females I was not able to identify so readily as I was the males. Some of the males I had marked, and of course I was able to identify them every time. These males all cleared up their nests three different times, and two

of them for the fourth time. But what led me to think that it was possible for the female bass to spawn more than once was from a little discovery I made on a dead bass. One morning I found a dead bass in the pond—the only case of dead fish I had seen since the original stock had been put in there, and I was anxious to know if I could identify the male or female by outside appearance. This fish appeared to be plump, and I decided in my mind it was a female, but to be sure I opened her. She had eggs in her, it was a female, and close examination of those eggs disclosed that perhaps one-half of them was pretty fully developed, another portion not so much developed, and still another portion a little more retarded. Now, if that should be the case when a bass first spawns, there might be a portion of her eggs ripe and ready to spawn and it might require a little period for the second batch to ripen, and likewise with the third batch.

Mr. Titcomb: I think Mr. Beeman's experience with the polygamous habits of another species there would perhaps confirm some of the observations about the habits of the bass. (Laughter).

Mr. Beeman: If the Society desire it I will take pleasure in giving an account of the incident referred to, regarding the common roach or sunfish. While I was gathering the crustacea for the small-mouth bass, my nets were placed in our mill-dam just back from the overflow where I got the right current of water. In passing out on this dam right at the crossing, a roach came up there and cleared up his bed the same as the bass; cleared off the sand and dirt, leaving the gravel in the center of the nest the same as bass do in their wild state. The first female to enter the nest was the little roach that you would suppose too small to spawn, she was in the act of spawning. This bed was so placed that I was able to get very close to it; they did not seem to mind my presence at all; I was able to observe the operation very closely; I threw a plank across from the corner of the wall, running at right angles with the dam, got out on the plank, and my face was within a foot of the fish. This little female was depositing her spawn there; perhaps she continued a space of two or three minutes. While I was watching her, another female of a larger size came into the nest; I could see plainly her sides very much distended with spawn; the male undertook to drive

this second female out of the nest, but she persisted in her efforts to stay there; she overcame his efforts to drive her out, and finally he turned on the little one which had been spawning and drove her out, and immediately began to give his attention to the second female. This continued on for a time and to my surprise a third female larger than either of the other two came into the nest. After the male had gone through the same tactics as before, that is, attempting to drive this intruder out, the female that was at that time spawning with him was driven out, and the third female began to spawn in that nest. After a time the little female No. 1 roach came back again, and the larger one left and the small one began again to deposit her eggs. After a time No. 2 came back, driving out No. 1, and No. 3 female came back in turn. As my time could not be devoted entirely to observing the whole rigmarole, and I had seen enough to satisfy me that there were some things in nature that we do not quite understand, I left and went about my work; but of course I was passing back and forth often and every time I passed I observed the operation which was continued for about four hours, that is, spawning with one another of the females. During the spawning time I was so close to the nest that I could see the eggs when they were discharged from the female; they were discharged right against and directly underneath the vent of the male, the male remaining perfectly upright and the female turned at right angles to the male. They were driven out with force enough to impel them four or five inches into the water beyond, and then they settled on the gravel. I could not tell how many eggs were deposited. Each time the female turned on her side there appeared to be a muscular contraction of the abdomen which drove the eggs out with quite a little force; but as near as I could judge there were about fifty discharged each time when she turned on her side.

Mr. Titcomb: What was the effect on the male?

Mr. Beeman: At noon the male was pretty well exhausted—he was trying to fan the eggs. (Great laughter).

The eggs hatched on the fourth day. At this time the male began to take in its mouth sand from just outside of the nest, dropping it right on the fry. This he contined to do until the newly hatched fry were completely covered. Then he immedi-

ately began to make a new nest just at one side of the buried fry. When the new nest was ready, the females came in and spawned a second time. The male then gave his attention to their eggs, driving away intruders. In due time the buried fry came up out of the sand and started out in life on their own hook, while the male remained on duty.

Secretary: Since the meeting at Woods Hole, Mr. Beeman writes as follows regarding the subject of bass spawning:

"Since my return from the meeting of the American Fisheries Society at Woods Hole, Mass., I have taken time to look over my memoranda of what took place at our hatchery during the spawning season. I find that the three spawning periods extended over a period of seven weeks. The first eggs were deposited on May 10th, and the last nest was deserted on June 28th. The third spawning was a total loss. Water temperature at the time fell to 59°, and may have been responsible for the loss. Had this last spawning hatched the period would have been extended some two weeks, had the fry fully developed. There were twenty-four breeding bass in ponds, eight of which were males. One was a small bass of about one-half pound which did not select a nest or spawn so far as I am able to discover, so I am uncertain as regards its sex.

"This would leave fifteen females, which gave twenty-eight separate deposits of spawn during the three spawning periods. As I am unable to identify all of the females I cannot say positively that they all spawned even once, but from the fact that there was twenty-eight separate deposits of eggs during the three periods, it clearly shows that the greater part of the females spawned at least twice.

"As I was able to identify some of the males, I find that two of them actually gave their attention to five females each during the spawning period of forty-nine days.

"Another peculiar and interesting thing in connection with the spawning habits of the small-mouth black bass was observed during the first spawning period. On May 11th two males had selected boxes Nos. 2 and 3, and were each giving their attention to a female in their respective boxes. Male in box No. 2 about two and one-half pounds. His mate about same weight. Male in box No.

3 about three-fourths pound. His mate four pounds. In due time both females deposited their eggs, and when I left the hatchery for the night, both males were fanning the eggs in their respective boxes. Early next morning found male in box No. 2 had apparently driven off small male in box No. 3, and was giving his attention to both boxes. These boxes were about forty feet apart. For two days this male could be seen going back and forth fanning the eggs in the two boxes, remaining in each box for two or three minutes. About this time, the small bass of uncertain sex, which I have before referred to, found that while male No. 2 was fanning eggs in that box, that box No. 3 was without protection, so he immediately began to devour the eggs there. When male No. 2 returned to box No. 3, he immediately drove off the intruder. Then entering the box would fan eggs. Then a short time after he would return to box No. 2 again. During this interval the robber bass would enter box No. 3 and continue his destructive work, until again driven out by the return of male from box No. 2.

"During the day the robber devoured all of the spawn in box No. 3. After this, male in box No. 2 gave his entire attention to his own box and gave us a fine school of fry.

"My conclusions were that all of the males should be as near of a size as possible. Then no one would be able to drive off another and take possession of his nest."

BAIRD MEMORIAL EXERCISES.

The American Fisheries Society meeting was called to order July 22nd, 1903, at 2:30 p. m., on the grounds of the United States Fish Commission at Woods Hole, Mass., for the purpose of conducting memorial exercises in honor of Spencer Fullerton Baird.

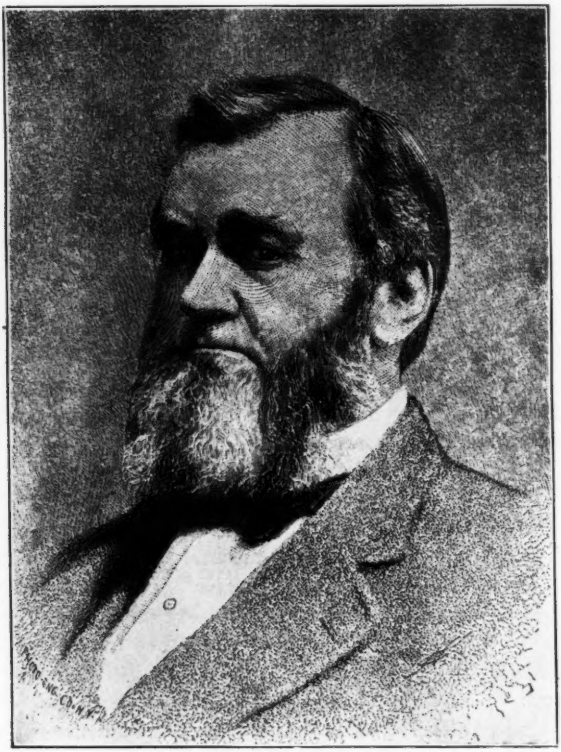
The meeting was called to order by the President, who spoke as follows:

At a meeting of the American Fisheries Society a resolution was passed suggesting the erection of a tablet to the memory of Prof. Spencer F. Baird, an appropriate tribute and recognition of his distinguished labors in behalf of fish and fisheries and biological science. A committee was appointed to raise the necessary funds, and as that committee has faithfully performed its duty we are here today to dedicate this memorial. It is certainly especially fitting that such a tablet should be erected at Woods Hole, the scene of so many of his scientific achievements, and where his life's labors ended.

The Rev. Mr. Fisher offered the following prayer:

Almighty God, the giver of every good and perfect gift, we are gathered here today to do honor to the memory of thy servant who was instrumental in founding this institution. With sincere and humble gratitude to Thee we call to mind the noble gifts of mind and heart with which he was endowed. We thank Thee for his love of science and for his illustrious labors for the advancement of human knowledge. We return thanks for the simplicity and gentleness and loveliness of his character, for the nobility of his purpose in life, and above all for his christian faith. We pray that the remembrance of his devotion to his profession, and his holy and pure example may inspire us with a like devotion to truth and a like desire and purpose to lead the way among our fellowmen to a higher and more complete understanding of the revelation of Thy thoughts and purposes in the world of nature. Help us to be imitators of that which is good so that through our lives he, who is dead, may yet speak to the

world. Grant this our Heavenly Father through Thine only Son, Jesus Christ. And now in the exercises before us we ask Thee to direct us in all our doings with Thy most gracious favor,



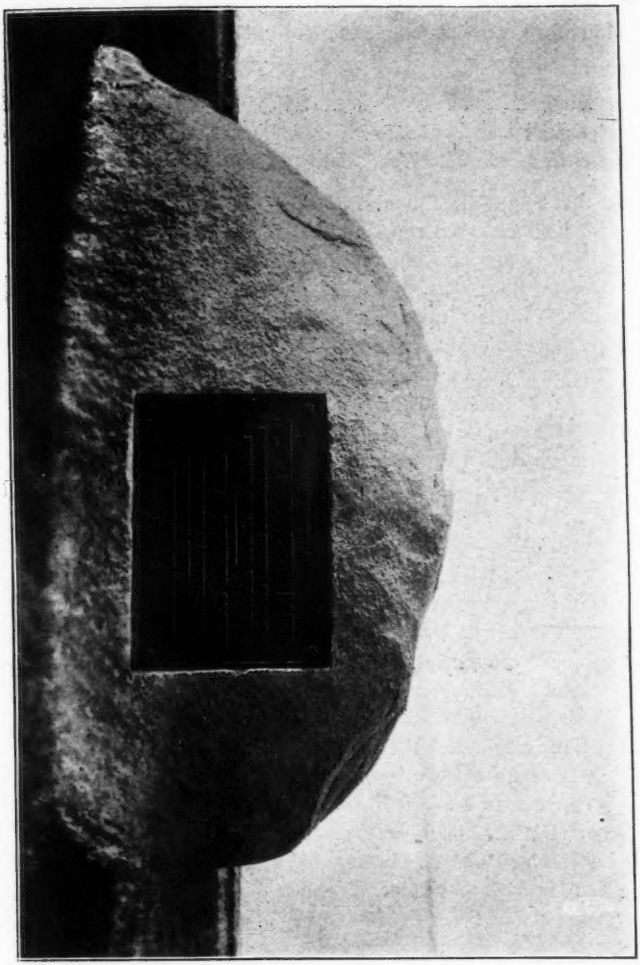
SPENCER FULLERTON BAIRD.

and to favor us with Thy continual love, that in all that we do we may glorify Thy holy name for Jesus Christ our Lord.

President: The tablet will now be unveiled by Miss Rose McDonald, Miss Eleanor Bowers and Mr. Vinol N. Edwards.

The tablet presented by the Society was then unveiled.

The President then read the inscription on the tablet, as follows:



"In Memory of Spencer Fullerton Baird, United States Commissioner of Fisheries, 1871-1887, The American Fisherie-

Society places this tablet in appreciation of his inestimable services to ichthyology, pisciculture and the fisheries. 1902."

President: It gives me pleasure to present to you Mr. E. W. Blatchford, who has been selected to deliver one of the addresses on this occasion.

Memorial Address at the unveiling of the Tablet erected to the memory of Professor Spencer Fullerton Baird, by E. W. Blatchford, LL. D. Woods Hole, Mass., July 22, 1903.

Mr. President, and Members of the United States Commission of Fish and Fisheries, and of the American Fisheries Society, Faculty and Students of the Marine Biological Laboratory.

Ladies and Gentlemen: It is three years since I had the honor of urging upon the American Fisheries Society, in response to resolutions presented by Dr. Smith, the erection of a monument to the memory of Professor Baird, and the appropriateness that such memorial should be located here, the scene of much of his most successful and distinguished scientific labor. The proposition met with an enthusiastic response, both from your society and afterwards from the United States Commission, which promptly assigned this most eligible point. A committee in charge of the work was appointed by the society with Dr. Hugh M. Smith as chairman. Under his thoughtful and efficient direction the plans were perfected, a granite boulder of worthy dimensions was found on the adjacent island of Nonnamesset, was brought and placed in position, and a commemorative tablet of bronze was designed and executed. To unveil this tablet do we meet here at this hour. Your committee would express their regret that the prosecution of important scientific investigations by the Government in the western Pacific Ocean prevents the presence with us of our honored chairman, Dr. Smith. He sends me his regrets that he cannot unite with us on this day, which was, on his suggestion, postponed a year that we might have with us the members of the American Fisheries Society.

It is due to this audience, as it is to myself, that I state that a friendship with Professor Baird of some thirty years was the argument that induced me to take part in these exercises. The time allotted will admit of but a slight sketch of some of this

valuable life. For data in its preparation I am indebted largely to the memorial tribute of his esteemed friends and associate, George Browne Goode, and to other sources as well.

"Spencer Fullerton Baird was born in Reading, Pennsylvania, February 3, 1823. His ancestry on the one side was English, upon the other Scotch and German. His great grandfather on the mother's side was the Reverend Elihu Spencer, of Trenton, New Jersey, one of the war preachers of the Revolution, whose patriotic eloquence was so influential that a price was set on his head by the British government. His father, Samuel Baird, who died when his son was ten years old, was a lawyer, a man of fine culture, a strong thinker, a close observer, and a lover of nature and of out-of-door pursuits. His traits were inherited by his children, but especially by his sons Spencer and William. The early education of Spencer was obtained at a Quaker boarding school at Port Deposit, Maryland, and at the Reading grammar school. In 1836 he entered Dickinson College, and was graduated at the age of seventeen. After leaving college, his time for several years was devoted to studies in general natural history, to long pedestrian excursions for the purpose of observing animals and plants and collecting specimens, and to the organization of a private cabinet of natural history, which a few years later became the nucleus of the museum of the Smithsonian Institution. The inheritance of a love of nature and a taste for scientific classification, the companionship of a brother similarly gifted, tended to the development of the young naturalist, and a still more important element was the encouragement of a judicious mother by whom he was permitted to devote the five years immediately following his graduation to his own plans instead of being pushed at once into a profession. In 1841, at the age of eighteen, we find him making an ornithological excursion through the mountains of Pennsylvania, walking 400 miles in twenty-one days, the last 60 miles between daylight and rest. The following year he walked more than 2,200 miles. His fine physique and consequent capacity for work were doubtless due in part to his outdoor life during these years.

"During this period he published a number of original papers on natural history. He also read medicine with a physician, attending a winter course of lectures at the College of Physi-

cians and Surgeons in New York in 1842." His medical course was never formally completed, although in 1848 he received the degree of M. D., *honoris causa,* from the Philadelphia Medical College. In 1845 he was chosen "professor of natural history" in Dickinson College, which I find included the strange combination of "teaching the seniors in physiology, the sophomores in geometry, and the fresmen in zoology." His summers, however, were devoted to extended collecting expeditions—to the Adirondacks in 1847, to Ohio in 1848 to collect, in company with Dr. Kirtland, from the original localities of the types, the fishes described by him in his work on the fishes of Ohio, to the mountains of Virginia in 1849, and to Lakes Champlain and Ontario in 1850. I may say that at that very time Dr. Kirtland discovered on the bank of the great lakes the bird which has since borne his name. In 1848 he declined a call to the professorship of natural science in the University of Vermont. In 1849 he undertook his first extensive literary work, translating and editing the text for the "Iconographic Encyclopedia," an English version of Heck's *Bilder-Atlas* published in connection with Brockhaus' *Conversations-Lexikon.*

A large field now opened before Professor Baird. On the urgent recommendation of the late George P. Marsh he was elected an officer of the Smithsonian, and on July 5, 1850, he accepted the position of assistant secretary of this institution, and on October 3, at the age of twenty-seven years, he entered upon his life work, pursued with indefatigable earnestness in connection with that beneficent national foundation. Its aim, as well as the key to the consecrated life of Professor Baird, is found in the motto of the institution and of its generous founder, James Smithson, *"The increase and diffusion of useful knowledge among men."* One evening I was sitting with Professor Baird before an open fire in his private library at Washington, and said, "A friend in Chicago has had a motto placed over his library mantel and I would like to see one over yours." "What is it?" he quickly asked, and I suggested "as typical of your own life work"—"The increase and diffusion of useful knowledge among men." He brought with him to Washington methods of work developed in his own personal experience, which became at once the methods of the establishment." His

scientific enterprise, however, was not unknown to the Smithsonian authorities, for we find that "the first grant made by the institution for scientific exploration and field research was in 1848 to Spencer F. Baird, of Carlisle, for the exploration of the bone caves and the local natural history of southeastern Pennsylvania." The thorough preparation and influential position in the world of science with which he entered upon these duties is evidenced by the friendships and partnerships he had during these early years already formed with leading naturalists on both continents, and the system of exchanges which in connection with his private enterprises he had developed with European and American correspondents.

I have spoken of his connection with the eminent Dr. Kirtland in 1848. Ten years before that he had met Audobon and had felt the stimulus of his friendship, proved by Audobon's gift to his young friend in 1842 of the greater part of his collection of birds, and most of his types of new species. It was a keen disappointment to both that the illness of Baird prevented his accompanying Audobon as his secretary on his six months' trip to the Yellowstone Park in 1840. The early correspondence with such men as George N. Lawrence in 1841; with Cassin and John G. Morris in 1843, and with Brewer, and Haldeman in 1845 influenced Baird's after life. In 1847 he met Agassiz just arrived from Switzerland in company with Desor and Girard. How natural was the sympathy immediately developed between these congenial spirits is shown by the fact that within a year was projected the work of Agassiz and Baird on "The Freshwater Fishes of the United States." "In 1843 he translated Ehrenberg's 'Corals of the Red Sea' for Prof. J. D. Dana, then preparing his reports for the United States exploring expedition, and in 1846 we find him in Boston consulting the libraries of Amos Binney and the Boston Society of Natural Sciences for preparing a "Synonymy of North American Birds."

Before this audience I need not dwell upon the signal influence of Professor Baird in the encouragement of scientific enterprise from the time of his entering upon his official connection with the Smithsonian. The Department of Explorations from the start was under his charge. What that meant of laborious but euthusiastic work in organization of the extensive govern-

ment expeditions, selecting commanders, nominating collectors, employing artists, and often editing the zoological portions of the reports, with the immense home and foreign correspondence involved, can only be estimated by an examination of the voluminous and systematic records of the institution.

Thus have I gathered what seems a very meager sketch of the development of the life of Professor Baird up to the time when in 1874 the office of Commissioner of Fish and Fisheries was established, to which office he promptly received the appointment. And what a wealth of knowledge, study, observation, administrative ability he brought to this most attractive field of research and public utility. There is no need that time be given here to detail the work of the United States Fish Commission. With its three-fold object you are familiar—first, the systematic investigation of the waters of the United States and the biological and physical problems which they present; second, "the investigation of the methods of fisheries, and the statistics of production and commerce of fishery products; and third, the introduction and multiplication of useful food fishes throughout the country." This annual gathering bespeaks the intelligent interest which from all portions of our country centers in this beneficent work.

It remains that I briefly sketch a few traits of the noble man who organized this work and in whose memory we are met at this hour. Though these have been often dwelt upon by those in intimate official connection with him, the occasion demands a few reminiscences, in which you will pardon some allusions of a personal character.

It was in connection with the organization and administration of the Chicago Academy of Sciences about 1868 that my acquaintance with Professor Baird first began. I had become interested in him through his papers on birds, but still more through my friend, his eminent predecessor in the Smithsonian, Professor Henry; and also through the glowing enconiums of Professor Agassiz, both of whom had visited our city. The first impression made when I came in contact with him was of a man of indefatigable activity of body and mind. This impression was correct, and subsequent acquaintance, whether in the Smithsonian, or in his own home in Washington, or in his summer

quarters at Woods Hole, when surely recreation should have been secured, corroborated that first estimate. What a proof of tireless devotion is given n the bibliography of his publications prepared by Dr. Goode, issued in 1883. This list embraces 1,063 titles, of which 73 relate to mammals, 80 to birds, 43 to reptiles, 431 to fishes, 61 to invertebrates, 16 to plants, 88 to geographical distribution, 46 to geology, mineralogy, and paleontology, 45 to anthropology, 31 to industry and art, and 109 to exploration and travel. I know of no such evidence of tireless devotion in existence, where you consider the number of the contributions, the breadth of research involved, the thoroughness of treatment, and also take account of the constant burdens carried by the writer in administration of three great organizations—the Smithsonian Institution, its ward, the National Museum, and the Fish Commission. And to such a life did the world bear abundant testimony. Almost every civilized country paid him honor. Honorary degrees came to him from the universities and colleges of our own land, and I know of no prominent scientific society but what claimed him in its honorary membership. All realized indebtedness due to one who was a perennial spring of enthusiasm in departments of scientific effort so varied. Mention should be made of testimonials bestowed by foreign countries. In 1875 he received the decoration of Knight of the Royal Norwegian Order of St. Olaf from the King of Norway and Sweden. In 1878 he was awarded the silver medal of the Acclimatization Society of Melbourne, and in 1879 the gold medal of the Societe d'Acclimation of France. He bore corresponding, or honorary memberships in zoological or botanical societies in London, New South Wales, Vienna, Lisbon, New Zealand, Batavia, Buda-Pesth, Cherbourg, Jena, Halle, Nuremberg, Quebec, Berlin.

"It was a touching tribute to Professor Baird's services that was received soon after his death from Yizo, the most northerly island of the Japanese Archipelago, in the form of a little volume beautifully printed upon silk, containing his portrait and the story of his character." Perhaps Germany more than any other country recognized the importance of his services to fish culture. In 1880 at the first great International Fishery Exhibition held in Berlin, the magnificent silver trophy which was the first prize was awarded to him by the Emperor William. It has

been stated that while Professor Baird's portrait hung over the entrance to the American section at Berlin, the Kammerherr von Behr, the president of the German Fishery Union, the most influential fishery organization in the world, never passed under it without taking off his hat in honor of the "first fish-culturist of the world," as he delighted to call him. The nomenclature of zoology contains many memorials of his connection with its history. A partial enumeration shows that over twenty-five species and one genus of fishes bear his name, and that not less than forty species have been named in his honor. These will for all time be monuments to his memory as lasting as the institutions which he founded.

To his friends who know him best and miss him most it seems pleasanter to dwell upon the recognition which his labors received than upon the labors themselves, his devotion to which so shortened his life.

Time forbids any analysis of the character of Professor Baird. Indeed the occasion, and my personal relations to him to whose memory we consecrate this hour favors no critical sentiment. I may briefly present a few characteristics which memory brings before me. And first there stands out his modesty, always impressive whether in personal contact or in his writings. Although constantly before the public he seemed never to care for public recognition. Throughout a long life given to the public service, I find but one instance where he was induced to take the platform in a public place. This occurred a few months before his death when Harvard University conferred upon him the degree of LL. D., as "an eminent promoter of science."

"No man was more easily approached than Professor Baird. His reception of young persons, especially those with an inclination to natural history, was particularly charming, at once relieving them from embarrassment and captivating them by his unassuming manners, his geniality, and frankness." I wish there were time to present instances of these traits. They irradiate through his whole life. His unfailing geniality was proverbial. These characteristics secured for him the favorable consideration of congressional committees when presenting his requests for money to be used in the expanding work of the Fish Commission or the National Museum.

May I mention one other very marked trait in Professor Baird? His aversion to personal controversy, so decided that under no circumstances could he be drawn into one, and this when as a pioneer in scientific research his views always frankly expressed called out frequent criticism. One who knew him well writes: "One of his striking characteristics was that he would never quarrel, and never have anything to do with the quarrels of others. He was always for peace."

But the earthly end of this noble life drew on. Nature could not longer endure the strain which for nigh half a century unremitting, unselfish devotion to the promotion of science had made upon mind and body. For many months before the end, Professor Baird knew that the closing shadows were gathering. The public realized it when with startled sorrow early in 1887, at his request the Regents of the Smithsonian authorized the appointment of Professors Langley and Goode as assistants. The aid came too late. In the early summer he returned to Woods Hole, vainly hoping its pure air and cool breezes might still permit some participation in his loved Fish Commission work, and this satisfaction was to some extent granted him. His life was now restricted, and with many results of his life work about him, he calmly waited the highest summons. In this period of weakness it was his pleasure, placed in a wheel-chair, to be moved around the pier, past the vessels he had built for research, and through the laboratory where many were at work in biologic investigations. For everyone he had words of good cheer, well knowing they were words of farewell. His thoughts were with his work up to the very last. On that last morning one of his most faithful assistants, one who is now honored by us all for the valuable work he is doing for the Fish Commission, called upon him, as was his daily habit, in the early morning, when Professor Baird said to him: "I wish you would set a trap off Butler's Point (indicating the exact location), I think you may secure something there." He left immediately in his boat, and went about the work. While setting the poles for attaching the net, he glanced over to the Fish Commission Building and saw that the flag had been placed at half-mast. He rapidly rowed back and found his chief lying in the present office—gone! The end came when after a brief period of unconsciousness he breathed his last

on August 19, 1887. "Of all the tributes to his character none was more eloquent than one at the funeral services, which were held in the Fish Commission building. The simple burial service had been read, when the clergyman recited these words from the Sermon on the Mount: "Blessed are the merciful, for they shall obtain mercy. Blessed are the pure in heart, for they shall see God. Blessed are the peacemakers, for they shall be called the children of God."

President: The next address will be delivered by Prof. William C. Brooks of Johns Hopkins University, a warm personal friend of Prof. Baird during his last years.

Prof. Brooks said: Mr. President, and Members of the American Fisheries Society: I thank you for this opportunity to speak of the work of that great scientific investigator, Spencer Fullerton Baird. The subject is a most inspiring one, but I know I shall have your sympathy when I say that it is also an overwhelming one. The field of Prof. Baird's productive activity was so wide and so diversified that no one can venture to present it or try to present it in a comprehensive view, and even if abandoning that attempt we pick out some one of all Prof. Baird's services to science and to his country and to the world, we find then that anyone who will adequately treat one of these subordinate divisions of Prof. Baird's work, must give to it long preparation, and must also give to it peculiar fitness and training for the work.

One must be an ornithologist, and an ichthyologist, and an explorer of the deep sea, and he must have in his mind the whole history of these departments of biological science, if he is to speak of the contributions to these varied aspects of natural knowledge which we owe to his earnestness and industry and scientific insight.

One must search the records of the Smithsonian before he can venture to speak of the results of his long service to this institution as its secretary, and one must know its later history, in order to understand the permanent influence of his administration.

One must know how the collections which he brought together overflowed its crowded cellars and dimly lighted corridors, until he laid the foundation of the National Museum, and

established it so firmly, and made such wise and skillful provision for its growth and improvement that it has quickly outgrown the generous limits of the home which he provided, and must soon be cared for in a still more stately and commodious building.

One must know the history of the National Academy of Sciences, to understand his part in the organization of this body of eminent men to be the advisors of our government on those affairs of state which call for the experience and technical knowledge and judgment of scientific experts.

No one who has not seen the work of the United States Fish Commission, in all its details, upon land and sea; its work of exploration in our streams and lakes, and along our sea-coast, and in the depths of ocean; its success in protecting and preserving and increasing the aquatic supply of human food; the contribution it has made to the peace of nations by protecting and defending our fisheries from international complication; its work of biological research in the laboratory and the museum—no one who has not seen and studied and reflected upon all this until he has come to understand it in all its interrelations with economics, and biology, and education and statesmanship, and intellectual development, can venture to speak of this, the greatest of Prof. Baird's creations.

Finally, no one who did not enjoy the life-long confidence and friendship of Prof. Baird can take the liberty of telling of the sweetness and grand simplicity of his nature, of his quick and lively sympathies, of the magnanimity and disinteredness and directness of thought which were shown in his every word and act. I knew him but little, and only near the end of his days, and while I was able to perceive how much these qualities, which so endeared him to all who knew him better, contributed to the success of his great undertakings, I have no right to talk of him from this personal standpoint.

You are all as familiar with his great achievements as I am. You know that he increased the efficiency of the Smithsonian Institution for the diffusion of knowledge. You know that he conceived the plan for a National Museum, and put it into execution. You know that he was one of the founders of the National Academy of Science, and that he was prominent in its

councils. You know that this laboratory, is his work, and that he was the father of the Fish Commission, and that all its diversified lines of activity were clearly and definitely outlined by him and that they have become the accepted standard and model for similar undertakings, the world over.

I should have found it a pleasant task to have made some one of these great achievements the subject of this address. I should have found profit and instruction in discovering the obstacles and difficulties which Professor Baird overcame, and in studying the tact and wisdom with which he planned and executed all his undertakings. It would have been a congenial occupation to have seen and mastered all the ramifications of the activity of one of these great creations of his genius; its growth from the foundations which he laid, along the lines which he so clearly foresaw and provided for; but I regret that it has not been in my power to handle any of these topics today; for the high honor of the opportunity to speak of the work of this great naturalist and many-sided man of science, came to me, only a few days ago, far from books of reference, and means of inquiry, at a little laboratory which I had set up at a remote point, in order to complete, in a cool climate, a biological research for which I had gathered the material, in the early part of the summer, at the new laboratory of the United States Fish Commission, at Beaufort, North Carolina.

After the completion of the central station at Woods Hole, it was Prof. Baird's plan, announced many years ago, to promote the study of marine biology by the erection of laboratories at points upon our sea coast selected for their natural advantages; and I cannot too highly commend the wisdom which has led his successors to select Beaufort for the first step in the movement to give effect to his intention.

The new laboratory, which was opened last summer, is a carefully and skillfully planned and beautifully constructed building; and it is, in all things, a model and an object lesson, for I have never seen a more convenient and comfortable and attractive laboratory.

It stands alone upon a little island close to the town of Beaufort, and it is within easy reach of the fauna of the North Carolina sea-coast, in all its wonderful richness and variety and in-

exhaustible abundance. It is thoroughly equipped with everything that the investigator can ask, and with all the comforts that he needs to make his life a pleasant one in the southern summer.

I cannot describe to one who has not lived and worked in this laboratory the care and thought and intelligent foresight that have been shown by those who have had it in their charge to put the plans of Professor Baird into practice, and to foresee and provide for all the needs of the investigator.

I have myself spent many summers at Beaufort with scanty facilities, and under many hardships and privations, and I had come to consider them the necessary incidents of summer work in the waters of North Carolina, so that I was lost in amazement to find myself surrounded with comforts and conveniences at the new laboratory, as I reflected that the investigator who works there in future years will have no thought of Beaufort, except as a place where every advantage is to be enjoyed without any discomfort.

They will owe these good things, as I have myself owed many opportunities to Professor Baird; so, reluctant as I was to lay aside my own work when my invitation came, I felt that it was not only a privilege but a duty to leave my microscope and my embryos, and to come here today to bear witness to my own great debts to him and to remind the younger generation of naturalists how much they owe to him.

As I have not been able to refer to the publications in which the story of his great achievements is recorded I cannot enter into a specific account of any of his great works, so I must try, as well as I can, to look at them from a more general standpoint.

It is in all modesty that I undertake this task, for the life and works of a great man like Professor Baird teach many lessons to many men, telling each one only that which he is best prepared to hear and to understand. I am well aware that he who ventures to read to others the lesson of such a life may only succeed in laying bare, to some one of deeper penetration, his own inability to grasp its truest and best meaning.

Professor Baird's public life began at a time when the scientific bureaus of the government, which have grown and multi-

plied with such rapidity in our day, and have become so prominent, and complicated, and important, were in the air, although they had, as yet, hardly begun their existence in tangible form.

There was need for a leader and an organizer; for a man who, while well trained in some branch of science, and thus qualified to distinguish the mere pretender from the true investigator, was also endowed with the breadth of view and the catholicity of interest which fit one for generous admiration for success in other fields, and lead him to do all in his power to promote it.

A man was needed who could inspire the confidence of his colleagues and contemporaries, sympathize with and encourage the young, reconcile the rivalries and jealousies of his fellow workers; and thus bring it about that as the various scientific bureaus of the government began to be organized and equipped for their duties, they grew up in a spirit of friendly co-operation and mutual aid.

There was need for a man whose integrity and unselfishness of purpose and earnestness and simplicity of character, and clearness and directness of thought and speech and action were so evident and so universally known and esteemed, that he could command a friendly hearing from the seat of government, and gain the intelligent interest and support of congress for new and expensive plans to extend the scope and increase the efficiency of our scientific bureaus.

Professor Baird was eminently fitted for this peculiar and difficult field of usefulness. He had many able and eminent allies and fellow workers, and while he must not have all the credit for the wisdom with which the scientific work of our government was organized and co-ordinated, it is nevertheless a fact that there are few scientific bureaus which do not still exhibit the impression of his hand, while some of them are his alone.

My own acquaintance with him began in the later years of his life, at the time when he was fully occupied in developing the plans and in laying the foundations upon which such stately edifices have been reared; so I am unable to speak of his younger days; but I cannot believe that he willingly turned aside from his earlier studies of ornithology and general natural history, or

that he abandoned these pursuits for the weary and vexatious work of administration without a struggle.

He perceived the needs and the opportunities of his day, and he knew his own ability to make a wise use of these opportunities, and he entered into the work which lay nearest his hand with all the enthusiasm and energy of his kindly and disinterested nature.

The institutions with which the name of Professor Baird is associated and the works to the encouragement and promotion of which his life was devoted, exhibit a three-fold purpose: to promote the progress of natural knowledge through researches in laboratories and in museums, and through explorations and discoveries, and through the reward of membership in the National Academy of Science; to diffuse and distribute it among men by means of publications and museums and exhibitions; and to advance its application to the material needs of mankind through the protection and regulation and development of the bounty of nature. We are too apt to look at these three aspects of science as three distinct and independent fields each of which may be successfully cultivated out of all relation to the others. Thoughtful scientific investigators, who ought to know better, are not always free from a feeling of superiority to those who devote themselves to its diffusion, or to its practical application; and, some, who are less thoughtful, have been heard to speak in disparaging terms of the mere popularizer, and of bread and butter science. Some of them have even been known to boast that the object of their own researches is so far removed from the possibility of practical application that it can never, by any possibility, be put to any conceivable use whatever.

I am not able to say anything about the secret reflections of those who have grown rich through the practical application of scientific discoveries, but I have an impression, that their respect for the investigator who, while he may earn his bread, has but a small share of the world's butter, is not very great, and that they do not always look upon him as one whose life has been altogether successful.

No one has ever been more free from every trace of this littleness of mind than Professor Baird. To him the promotion of science, and its diffusion, and its practical application, were not

three independent ends which could be attained by different means. He was as well aware as Francis Bacon that it is only in the co-ordination of these three aims, and in the maintenance of a just and equal balance between them, that science finds its true inspiration, and its very life. It may be that the naturalist is better prepared than other men of science to perceive this. The practical application of natural history to the material needs of mankind is not, commonly, of the sort for which men pay money. It is like the rain and sunshine. It is not thought of as enriching any, because it enriches all. It is, no doubt, for this reason, that there is more mutual respect and regard and good fellowship between those who devote themselves to research and those who are occupied with its practical application in this province, than there is in other branches of science.

As Professor Baird was a naturalist, he was better fitted than most men of science for diffusing and applying natural knowledge, as well as encouraging it and contributing to its advancement; and all his undertakings bear witness to the soundness of his judgment as to the balance which should be maintained, in a bureau of our government supported by the people of our country, between these three purposes, and the way in which success in the accomplishment of each of them should be made to contribute to the sound and healthful progress of the others. This is, in my opinion, one of the most instructive lessons of his life and work, and it is nowhere more clearly illustrated than in the organization and operation of the Fish Commission. It is because of the wisdom and foresight with which the Fish Commission has been so organized and conducted as to bring this about that it has come to be looked upon, by foreign governments as a model to be studied and copied.

The purpose for which it is maintained by our citizens is the improvement of our fisheries, and it has seemed to some that deep-sea explorations and research in laboratories are no part of its duty to the public, but Professor Baird knew that progress in the expansion and improvement of the economic work would soon come to an end without the aid of the student of pure science, and that the Commission would quickly degenerate into a mere clerical routine and mechanical round of perfunctory duties without the inspiration of scientific discovery.

All men prize the fruit, but he understood that the tree will soon be barren if we visit it only at the harvest; that we must dig about it and water it, and cherish the blossoms and the green leaves, else there will soon be no fruit to be gathered.

But I have no thought of coming before you today as a champion of pure science; nor do the people of America need to be informed that it is the fountain head from which all the arts that enrich our civilization are supplied. So I ask your leave to devote the rest of my time to the examination of a criticism which has been made of the practical work of the Fish Commission—an objection which, because of its plausibility, and because of the eminence of the authority who has been its most prominent advocate, has had great weight with many of the thoughtful and reflective, and has received the endorsement of many naturalists.

You all know that Huxley believed, and took many public occasions to declare, that marine fishes like the cod and the mackerel inhabit the ocean in such innumerable multitudes, and are so prolific, that the utmost efforts of man can have no practical effect upon their numbers, because they are exposed to the ravages of so many natural enemies that the destruction caused by man is not worthy of consideration in comparison. He is therefore led to believe that efforts to maintain them in their natural abundance or to add to their numbers by artificial propagation are misdirected and useless. Respect for Huxley's experience and good sense and sound judgment has led many to think that this opinion is sound and well warranted and when we reflect that innumerable millions of young mackerel and cod are born in a state of nature for each one that can be reared artificially, and that millions are born for each one that lives through the perils of infancy and survives to maturity, there does seem to be reason for doubting whether the efforts of man to affect the supply of marine fishes by artificial means can have any effect; for man's addition to their numbers is only as a drop of water in the ocean, and the chances of survival of any young fishes that are hatched by human aid and then cast into the ocean to share the perils of those that are born naturally can only be as one in millions.

Yet, with all deference to Huxley, I venture to assert that it

is he who has made a mistake, and failed to comprehend the problem of the life of marine food-fishes, and not Professor Baird and his successors, and that the burden of error is on his shoulders and not on those of the Fish Commission.

Marine food-fishes are enormously prolific because they are exposed to so many dangers and enemies. Natural selection has, in course of ages, brought about such an adjustment between the natural destruction of the individuals of each species and their birth-rate, that the number of mature individuals of the species is about equal to the resources of the natural supply of food, and remains constant on the whole, so long as the natural conditions of their life remain unchanged. But when a new disease, or a new rival, or a new enemy, which has not been provided for and guarded against by natural selection, invades their home and comes to stay, the destructive effect of this new element in their lives soon shows itself, even when its ravages are so slight, as compared with the total number of violent deaths, that it seems to be trivial and unimportant. Man is the most resistless and insatiable of destroyers. The fear of him and the dread of him is upon all the beasts of the field, and upon the birds of the air, and upon all the fishes of the sea, and upon everything that moveth upon earth, but he is not a part of that order of nature to which the birth-rate of marine animals has been adjusted. As a navigator and a sea-fisherman he is too new to have given natural selection time to have produced any compensating adjustment; and the quickness with which he invents new weapons of destruction, and improves himself in their use, far outstrips the movement of this slow process of modification; for the time he has needed to progress from the bone fish-hook and the hurdle of rushes to the steam fishing vessel is as nothing in the long history of species. It is, no doubt, true that the whole number of mackerel and cod and herring which he destroys is as nothing, when we compare it with the slaughter wrought by blue-fish and porpoises and dog-fish, and other sea-robbers, but this slaughter is provided for in the birth-rate, while that which he works is not. While a number of food-fishes greater beyond all computation than man destroys has been destroyed by natural enemies each year for ages without any effect upon their abundance, every one knows that when man turns his

energy and intelligence and inventive skill to the work of destruction he quickly brings about a very notable decrease in the supply. It is because the slaughter caused by man is infinitesimal that an infinitesimal increase in the birth rate is all that is needed to make it good, and this infinitesimal increase in the birth-rate it is, fortunately, within the power of man to bring about by artificial propagation. Instead of showing that efforts to maintain sea-fisheries by artificial propagation are misdirected and useless, the well known facts to which Huxley calls our attention, turn out when carefully considered and thoroughly understood, to afford the clearest proof of the prudence and wisdom and foresight and scientific knowledge of Spencer Fullerton Baird, the founder of and father of the United States Fish Commission.

President: We have with us today two members of the American Fisheries Society who are among the early appointees of Prof. Baird, both of them, as is well known, have made splendid reputations for themselves in connection with the United States Fish Commission. It gives me pleasure to present to this audience Mr. Frank N. Clark, of Northville, Michigan, who will address you.

Mr. Clark: Mr. President and Fellow Members of the American Fisheries Society, Ladies and Gentlemen: It is with a feeling of the deepest sadness that I undertake to tell to you my feelings towards the man whom this memorial tablet represents. It is true that I was connected with Professor Baird in the early stages of the Fish Commission. My association with him was from time to time, and during a period of about fifteen years when the Fish Commission was not what it is today, when the practical men of the Fish Commission were working in all manners and ways, as you might say, to get the Fish Commission started, and none of those practical men had a warmer friend in all the work than Professor Baird. He was an inspiration to them to do all they could in helping to establish the Fish Commission. I might tell you all that I feel and all that Professor Baird did for me, but my heart is too full to express it, even had I the ability to do so. Professor Baird was an inspiration in his talk, and many a talk have I had with him on the practical side of fish culture. Discouragements would arrive,

and through his talk and through his correspondence new inspiration was given. My friends, not having had time to prepare anything, as I was only spoken to to say a word in regard to this matter, I will now leave you.

President: The other gentleman I referred to a few minutes ago is Mr. Livingstone Stone, of Vermont, who will now say a few words.

Mr. Stone: Mr. President and Members of the Fisheries Society and Ladies and Gentlemen: I do not feel that I can add anything to the very able and interesting addresses which you have already heard, but at the same time I do not feel as if I could wholly decline to say anything on this occasion, for I am one of the few living early appointees of Professor Baird, who were appointed when the United States Fish Commission was started. It was my privilege to know Professor Baird from about the time the Fish Commission was inaugurated until the time of his death. It was also my privilege to be in somewhat close relations with him up to the time of his death. It is just thirty-one years ago this month, and almost thirty-one years ago this very day, that I was appointed by Professor Baird to be his deputy commissioner for the Pacific Coast, but if I should attempt to say anything at this time without preparation I should certainly not feel equal to the occasion; I should feel very far from equal to the occasion; however, just before I left home I happened to come across a copy of the Forest and Stream which had something in it which I wrote some time after Professor Baird's death, and although I think it is hardly fair or proper to inflict a printed page upon this gathering today, or upon any occasion, I feel sure that it would be much more satisfactory to you if I should read this quotation from Forest and Stream, than if I should try to make any fragmentary remarks without preparation. So with your kind permission I will read one or two extracts, but I will not take much of your time.

"The mere mention of Prof. Baird's name strikes a chord of dear memories in the hearts of all who knew him. No man of our time has left a purer memory, a more stainless name or a more animated or enduring influence over his special field of labor than Prof. Baird. He was loved by those who knew him when he was living; he is revered by those who have survived

him. Prof. Baird lived in a higher plane of life and breathed a purer atmosphere than most men. Quiet and unassuming, with a nature as gentle as a child's, his natural superiority never failed to show itself when he was with other men, not even among the distinguished men who gathered in the winter at the national capital. Yet he was thoughtful and considerate of his subordinates, and always ready to give his meed of praise of any work well done by his humblest employee. Prof. Baird had the enviable gift not only of endearing everyone to him who came in contact with him, but of inspiring them with his own enthusiasm and energy. This made congressmen vote him all the appropriations that he asked for; for it was a common saying at Washington that congress gave Prof. Baird everything that he wanted. Like a good general, he had the personal welfare of his men at heart while he was Fish Commissioner, and they in turn wanted to do everything in their power for him, which doubtless, was one of the secrets of his great success.

It is a fact that his employees in the Fish Commission would voluntarily work a great deal harder for Prof. Baird than they would for themselves. This fact is accountable for another saying at Washington at that time, that Prof. Baird's men were the busiest workers of all the departments. It was the inspiration of this patient, disinterested, tireless, kind-hearted and lovable man whose work they were doing that made them work so well, and also made their work a pleasure.

It is unnecessary to say that Prof. Baird possessed extraordinary mental endowments, but I perhaps may mention one or two, as they are so rare. He had a quickness of apprehension that sometimes seemed supernatural. For instance he would glance down a printed page and comprehend in a moment what would take others several minutes to read.

He had a marvelous memory, not only retentive of everything intrusted to it, but quick to call up anything that was wanted when it was wanted—a quality which most of us know well how to appreciate. His mind was also of the clearest type. No complications ever seemed to confuse him; he never became involved during his conversation, no matter what were the intricacies of the subject. His mind, like his placid temper, never seemed to be ruffled or disturbed. Extraordinary as his mental faculties were,

he had evidently added to their efficiency by severe discipline. for he possessed that infallible mark of a well-trained mind, of having all of his great and diversified stores of knowledge classified and grouped together in his brain according to subjects, so that he could call up his whole knowledge of any subject at a moment's notice. Another remarkable thing about Prof. Baird's mental composition was that with a thoughtful, scientific cast of mind were united qualities of the most practical character. Prof. Baird was a scientific man by nature. He loved science and scientific studies; but at the same time no man had a sounder judgment or a clearer head in the management of practical affairs than he did. It is very rare to see scientific and practical qualities of mind united in such an eminent degree as they were in Prof. Baird's.

Prof. Baird was gifted with still another unusual mental endowment which reminds one strongly of one of the traits of the first Napoleon. With that comprehensiveness of mind which takes in the broad features and large general outlines of a great enterprise, he combined, as Napoleon did, a capacity for close and thorough attention to all the details of a subject down to the minutest item necessary to success. This combination, as we all know, is a rare one.

Prof. Baird has been called a plain man. He was a plain man indeed, but one who was made after Nature's largest pattern of man. He was large in mental calibre, and large in physical frame; large in his broad sympathies and in his wide scope of vision; large in his comprehensive grasp of great aims, and large in his capacity for great undertakings; large in everything but small in nothing.

President: This closes our exercises, and on behalf of the American Fisheries Society I want to thank you for your presence here this afternoon and your courteous attention.

DISCUSSION ON BASS RESUMED.

Mr. Dean: I wish to refer to one or two points on this subject. We were talking about places where bass were hatched under good natural conditions. Both stations talked about the most have an immense growth of vegetation in their ponds; and I would like to know how to produce that growth. When it does not grow naturally what cause is there for it? There is a question there I have not been able to solve so far, and on that question hinges the question of natural food largely, and also the question of producing bass. I do not believe there is any trouble about producing bass if you have the natural food and the moss, but if you do not have those you cannot get very many bass unless you put them out as fry. Is it a question of soil, water, temperature or what? Mr. Leary says he hauls his ponds down in winter and leaves them dry from six to ten weeks; Mr. Lydell says he never hauls his pond down, and both claim to have an immense crop of vegetation. Some years we have plenty and other years apparently under the same conditions there is absolutely no vegetation.

Mr. Titcomb: Do you haul your pond down?

A. Occasionally.

Q. Do you leave it bare in the winter?

A. Sometimes, not always.

Q. Does not that kill your vegetation?

Mr. Clark: What is your theory in regard to the matter?

Mr. Dean: I have had so many theories and had them upset that I do not know as I have any now.

Mr. Titcomb: Have you had this lack of vegetation on the years following that when you did not draw the pond down.

Mr. Dean: After we draw the pond down for repairs vegetation does not always come up the first season, but the next year we get a good crop nearly every time. This year, for instance, one pond was full of vegetation in the spring and we hauled it down to take out the breeders and any other fish we did not want there. We mowed the vegetation in order not to disturb the roots, and afterward filled up the pond, and it was filled up as

soon as possible—I do not think it was dry a day, but the vegetation all died except a little around the inlet.

Mr. Titcomb: Don't you think the vegetation was killed in that case by hauling the pond down?

Mr. Dean: I don't know.

Mr. Riley: Did you ever try to pull it down in October?

Mr. Dean: No, in the spring, in March after the vegetation comes out; then the conferva comes in very thick and yet this pond which we call No. 14 discharged all its water in the pond below which is No. 7, and No. 7 has almost no conferva in it, yet the discharge from No. 14 which was full of conferva goes into No. 7 and does not produce any there to amount to anything.

Mr. Titcomb: Do you think March is the proper time to draw it down?

Mr. Dean: I would rather do it in February, but I could not do it then this year—I think it ought to be done a little while before the fish spawn.

General Bryant: What do you draw it down for, to secure a complete change of water?

Mr. Dean: No, sir, to arrange your spawners for the season's work, and to get out any undesirable fish that there may be in the pond.

Mr. Titcomb: It seems to me that Mr. Dean has answered his own question. He has drawn his pond down at an improper time.

Mr. Leary: Draw it down in October. As soon as your bass is distributed take your old fish, put them in a nursery pond and draw your brooding ponds down.

Mr. Dean: If we put our breeders in the pond the first of January by the first of July the pond would be so full of crawfish there could not anything grow.

Mr. Lydell: I do not see any other way for superintendents to work that out except to do so independently. Conditions differ at all different bass stations. We have no trouble at our stations as far as vegetation is concerned. We cannot draw the water all out of our ponds and there is always a foot or so in them.

Mr. Ravenel: How old are your ponds?

Mr. Lydell: Five years. The only way, as I say, is for the

superintendents to work the problem out themselves according to conditions of the country. The conditions even in different parts of the same state will vary.

There was some talk this afternoon when the specimens were being distributed in regard to what was fry and what were fingerlings. I have brought some specimens here. The age is not given for some of them, and Mr. Clark, of Northville, thought that those that I called fry were pretty large for fry, and I would like to exhibit these specimens here as showing what we ship as fry and what we ship as fingerlings. Of one size which I show you here we shipped this season 636,000.

(Mr. Lydell here exhibited a specimen somewhat less than an inch in length).

Mr. Titcomb: How do you count them?

Mr. Lydell: Two thousand or whatever we ship in a can and those are estimated, and these are what we ship as fingerlings, both the large and small-mouth.

(Exhibiting the same specimen referred to).

We ship lots larger and some smaller.

President: I would like to ask Mr. Clark what he calls those?

Mr. Clark: I do not call them fry.

Mr. Lydell: Perhaps we have 15,000 more of that kind to ship. What we ought to get at is where we are going to establish the fry and where the fingerlings. We ought to determine what to call them.

Mr. Leary: In your paper of last year you described fry as those just risen from the nest, and mentioned baby fingerlings three-quarters of an inch long to an inch long.

Mr. Lydell: Those fry are the small-mouth bass, but these are the large-mouth. I did not bring any of the small-mouth fry along this year, because I had them at the society meeting last year. You are correct about the statement.

Mr. Titcomb: Those are the smallest fry you ship?

Mr. Lydell: Yes, of the large-mouth fry.

Mr. Clark: I cannot conceive of the idea of any kind of fish, whether bass, trout or what it be, being planted and called a fry when it is a full-fledged fish. Now, I have never made a business of hatching and planting bass. I have examined some little

bass under the microscope, and I have taken bass even a considerable smaller than the specimens and looked at the outside of them under the microscope, and I cannot see any difference between a fish of that size and just a little smaller, and a full grown bass three or four inches long. They are the same. They are a full-fledged fish in shape. You have got the color here in the large mouth of the black striped bass, and I do not see why those fish should be called fry. Now, a trout in the condition of the specimen of course would be longer and larger—we would not call it a fry, and why should we call the specimen a fry? We call a trout fry about the time the sac is absorbed, and a little while after; but a two and a half to three months old trout we would not call a fry—it is not a fry, it is a partially grown fish. Now, that is just the case here. This is what I argued last year, that in my judgment it is just as well to plant those fish as it is to plant your two, four or six inch fish, exactly, excepting that you have protected them that much longer from their enemies—that is my idea of the fry and the fingerlings.

Mr. Lydell: I have here some large-mouth fry; but as we shipped them out that way I do not know what else you could call them. You would not call them fingerling, and therefore, we call them fry.

Secretary: Is there any difference between the large-mouth and small-mouth fry?

Mr. Lydell: We have shipped all of our small-mouth bass when they first rise from the bed, three or four days old, or else we do not ship them until they are fingerlings.

Secretary: Why should you distinguish between the two—one is a fry as long as the other.

Mr. Lydell: The large-mouth is a great deal larger than the small-mouth when shipped.

Mr. Clark: Of course Mr. Lydell would not advocate the shipment of the specimen?

Mr. Lydell: Oh no.

Mr. Clark: And you claim those are fry, as I understand it.

Mr. Lydell: Yes.

Mr. Ravenel: How much larger are your small-mouth shipped as fry than the specimen?

Mr. Lydell: About six times as large.

Mr. Seymour Bower: I think it is misleading to call these specimens fingerlings. I have called them advanced fry to distinguish them from larger or smaller fish. The term advanced fry or baby fingerlings might be used, but to call them fingerlings is misleading.

Mr. Clark: This matter of the bass fry and bass fingerling might possibly lead to as much discussion as years and years ago when hardly any of you were at the meeting, when we had the trout fingerling and fry discussion. I fought and fought and bled over that ground—I did not die—I am still here. (Laughter). Most of the rest of them, poor fellows, are dead, but I am still on earth. Now, I would suggest and if necessary make a motion, (of course you will not consider me in that motion) that a committee of three of the American Fisheries Society be appointed to settle the question of when the young bass shall be called a fry and when they shall be called fingerlings, for future definition, not only for the Fish Commission, but for all the state commissions and private hatcheries.

Mr. Seymour Bower: I do not think the committee should be confined to the terms fry and fingerling—they might wish to recommend or coin a new term for small bass midway in size between fry and fingerlings.

Mr. Clark: Certainly.

General Bryant: Have the committee establish a standard of weights and measures? (Laughter).

Mr. Lydell: Last year I called them baby fingerling in my report to the Michigan Fish Commission, and I was not satisfied with that, and so this year I just shipped them out as fry until they were fingerling.

Motion unanimously carried and Mr. F. M. Clark, Mr. Seymour Bower and W. DeC. Ravenel appointed as such committee.

Mr. Beeman: In regard to the question of fry and fingerling, our bass when they arose from the bed were black in color and they continued black until they were about an inch long; then they changed and grew lighter in color and took on the natural color of the adult. It strikes me that there would be an opportunity to draw the line, and that after they change the

color and take on the color of the old fish would be the time to call them fingerlings.

Mr. Bower: That would do very well with the small-mouth, but not the large-mouth bass.

Mr. Beeman: I would confine it to that.

Mr. Lydell: It seems to me we are all satisfied in regard to the small-mouth bass, but the large-mouth is what we are trying to get at, but everybody is satisfied that bass planted at that age are nearly as good as they are when twice as long. So I do not think the matter will develop anything very serious.

Mr. Atkins: I would like to suggest that the committee be authorized to consider the question of the name yearling. As I understand, it has been the custom to call fish six or seven months old, yearlings. I have never done it myself. In order to keep out of difficulty I have always stated the age of my fish in months—six, four or two as the case might be—but I have not adopted the name fingerling, because I could not determine just what it did mean, and therefore avoided using it. It would be a convenient term, and when this committee has decided what it means I shall be glad to adopt it. I think according to the dictionary and the usage in the nomenclature of other animals, no animal is called a yearling until it is a year old, and then it is a yearling until it is two years old; and it seems to me it would be entirely proper to adopt that standard with fish.

Mr. Seymour Bower: Would the gentleman consider the beginning of the year the time the egg is laid, or the time the fish hatches?

Mr. Atkins: The time the fish hatches.

Mr. Ravenel: That question has been raised very often in connection with the preparation of the United States Fish Commission reports. The difficulty arises from the fact that some fish are spring spawners and others are fall spawners; though we do call the fry resulting from eggs taken in the spring and fall, yearlings, when distributed in the fall, it has been based on the theory that the majority of the salmonidae distributed result from eggs taken in the fall, and we estimated the year as from the time the eggs were taken to the time the fish were distributed —where they were carried an additional year they were considered as two years old. The definition, perhaps, was not accurate,

but was a basis on which to make up reports, because we did not wish to individualize the age of the fishes from each of the stations. We had to adopt the same plan in designating the yearlings or fingerlings resulting from the black, spotted or rainbows, Rocky Mountains, etc., taken in the spring.

General Bryant: You cannot keep a register of births in these cases.

Mr. Ravenel: It would be impossible in distributing a billion four hundred million fish to indicate the age of the fish.

Mr. Atkins: However, the salmonidae are nearly all of them hatched in the spring and would be a year old the next spring, and not until then.

Mr. Titcomb: In the last report the fish have been classified under one column of fingerlings and yearlings. That brings the fish from six months to a year old in the same category in regard to distribution.

Mr. Atkins: I think in no other animal is it considered the rule to reckon the age from the time of conception rather than the time of birth. (Laughter).

Mr. Ravenel: We admit that.

A FATALITY AMONG FISHES IN WATER CONTAINING AN EXCESS OF DISSOLVED AIR.

BY M. C. MARSH.

For some years the fishes in the aquarium at the Woods Hole Station of the United States Fish Commission have presented a peculiar phenomenon consisting in the presence of gas bubbles clinging about their bodies and fins. Occasionally some of them developed in the membranes of the fins, or elsewhere large blisters which contained a gas, and would collapse when punctured. Others had bulging eyes, the affection commonly called popeye. There was some mortality among these fishes, but not to a serious extent, and fresh supplies of specimens were so readily available that no serious inconvenience was caused. But during the last fall and winter the losses did become serious and the aquarium exhibit could not be maintained without a new supply every few days, and sometimes more than half the stock would die within forty-eight hours after a lot fresh from the harbor had been introduced. The cleanliness of the aquarium tanks was thorough and the sea water which was successfully supplying the cod hatching operations, was apparently the same as usual.

The species of fishes at this time common at Woods Hole were the white perch, tautog, tomcod, flat-fish, and two kinds of sculpins. When these were introduced into the aquaria this curious development of gas bubbles upon the fishes became evident within about two minutes. The individual became completely covered with extremely minute bubbles which grew slowly larger until after ten minutes they were very conspicuous and appeared to envelop the fish in a delicate silvery white coating. Some species were more completely covered than others but all without exception developed the bubbles in greater or less abundance. As the bubbles grew larger they began to be released by the movements of the fish in swimming, and passed off at the surface of the water. New bubbles formed, however, to take the place of those released, and the fish seldom remained clear of them for

any length of time. If a well covered individual were taken from the water for a few seconds all the bubbles would dissipate in the air. After the return to the water the fish in a few minutes would be as well covered as before. The blisters in the skin, or on the fins, were not formed until after hours or days, and were of course more permanent, being surrounded by a thin membrane—a layer of the skin—and really within the fish itself. With some specimens the buoyant effect of the bubbles and the blisters together was plainly seen in the constant effort to swim down in order to keep below the surface. The evolution of gas bubbles was not confined to the fishes alone, but appeared upon the sides of the aquarium tanks and on nearly any mechanical surface submerged in the water.

It should be said that at other seasons, chiefly in the summer, "popeye" was common among the fishes, the scup being particularly affected. At the time of the occurrence of the mortality of the past winter the scup was not in season and the species then used in the aquaria did not exhibit popeye. While it is at least possible that this bulging of the eyes is due to the same cause as the gas symptoms here described, the popeye of the scup and other summer species is not necessarily included here. There is undoubtedly more than one kind of popeye.

These fishes soon died, after varying periods, some in a few hours, others living several days. Aside from the symptoms of gas already mentioned they showed but little external evidence of disease or injury. On opening them, however, a strange and unusual condition appeared. Gas was present in the larger blood vessels. The heart itself contained gas as well as blood, and was sometimes found with one of its chambers distended with gas to the exclusion of the blood. The vessel from the heart to the gills could be traced empty of blood, and the gill-filaments had each a plug of gas which plainly made the passage of blood impossible. In these cases the cause of death could be plainly due to suffocation. In some way gas had been liberated within the blood vessels and finally accumulated in such amounts as to entirely obstruct the circulation. The external gas already described evidently did no particular harm, but that within the blood vessels was fatal, as it is within the human vessels when present in any considerable amount.

The affection may be called a gas disease in consideration of the very plain lesions. But what is the gas, where does it come from, and how did it get free within the vessels? The first thought is of bacterial infection, for many bacteria produce gas. The microscope shows no organisms of this nature in the blood, and moreover, the blood is sterile when examined in bacteriological culture media. Bacteria do not cause the mortality. The explanation now to be offered falls somewhat short of absolute proof, but it explains so plausibly that proof of it is anticipated. The external gas is ordinary air. It does not emanate from the fishes themselves, but separates from solution in the water upon their bodies just as it does upon any other solid surface immersed in the water. This gas collected from its loose adherence to the exterior of the fishes and from the large blisters or vesicles in various parts of the skin, has been examined by the chemist and pronounced air with a slight admixture of carbon dioxide. The gas from within the vessels can not only be easily collected in amount and has not been examined chemically, but in the light of the other facts it is in every way probable that it also is merely air.

Now inasmuch as any water fit for fishes contains air in solution for their breathing purposes, and they live in it without such startling results as above described, this particular water is of extraordinary quality with regard to the air it holds in solution. The air is in excess; the water is supersaturated with it, and the excess constantly tends to escape in the form of small bubbles which gather on the fishes and other solids, and also insensibly at the surface of the water.

In order to understand how an excess of air gets in solution in the water, why it tends to pass off afterward, and how it has access to the blood of fishes, some general considerations are necessary. Water dissolves gases according to definite laws, the variable factors influencing solution being temperature and pressure. Cold water takes up more air than warm water, and under high pressure more than under low pressure. The waters of nature—the sea, lakes, rivers, brooks, etc.,—usually, but not always, take up air from their surfaces only, and at the atmospheric pressure, which is only slightly variable. Fishes in such waters are ordinarily accustomed to dissolved air, the maximum

amount of which would never exceed that which the coldest water would absorb at the highest atmospheric pressure. The depths of such waters are of course under an increased pressure, which is proportional to the depth, and if air were present at these depths the water would absorb an excess of it. By excess is meant always that amount over and above what the water could hold if it were at the surface and therefore under atmospheric pressure only.

Under natural conditions water will seldom acquire an excess of air. But under certain artificial conditions the water and air may be brought together under a greatly increased pressure more than the atmospheric. In this case an excess of air will be forced into the water. The water will become supersaturated. This is what occurred at Woods Hole. The arrangement of the water supply you can yourselves examine. A steam pump takes up water from the harbor through a long suction pipe and forces it up into two reservoir tanks. It flows thence by gravity to the hatchery and aquaria. The height of these tanks is about eighteen feet and the pressure at the pump is about eight pounds made by this eighteen foot column of water. The pump was found to be forcing, not water alone, but water containing many bubbles of air which entered presumably through a leak or leaks in the suction pipe. This air does not dissolve in the water to any great extent until it passes the pump, whereupon it enters the region of increased pressure and commences to pass into solution. We may assume that the sea water when it enters the suction pipe contains all the air it will hold at the temperature which prevails and at the existing atmospheric pressure. It may fall somewhat short of this, but the point is immaterial. At any rate, it reaches the storage tanks containing too much air—invisibly present in solution. It is now exposed to the air and some of the excess may pass off, but as water is constantly passing through the tanks there is no time for this process to accomplish much. It reaches the aquaria and hatchery boxes with its considerable excess of air, and it causes upon any fishes present the symptoms already described and which finally end in death.

The processes of release of the excess of air from solution, and of its appearance within the circulation of the fishes are to be considered. The pressure being removed, air begins to leave

the water spontaneously as soon as it emerges from the pipes. It passes off insensibly at the surface but it also gathers in visible bubbles on the sides of the tank and on the sides of the fishes, as already described. A solid surface excites the release of gas from a solution supersaturated with it, much as a crystal or foreign body will cause precipitation from a supersaturated solution of any readily soluble salt. The aquarium tank of water, holding many gallons, will, if the flow is cut off, lose its excess of air, but it takes a number of days; two or three gallons, in a hatchery jar, will lose it in two or three days; a teaspoonful, probably in a few minutes. If the water were warmed the escape of air would be greatly facilitated. While the aquaria contain fishes and there is a continuous flow of water, the supersaturation is constant and nearly equal to that within the pipes. The spontaneous release is so small as to be negligible as far as the fishes are concerned.

These fishes find themselves in much the same situation as a person who is subjected to a pressure of more than one atmosphere, as in a very deep mine, or as in the case of divers or workmen in caissons in bridge building. In either case the breathing apparatus has a task for which it is not adapted. The results are more disastrous with fishes than with people. The gill filaments of fishes are osmotic membranes, that is membranes which allow substances in solution (in this case particularly gases) to pass through them. The osmotic pressure is proportional to the amount of gas in solution. With this water containing an excess of air, the osmotic pressure is high, higher than the fishes experience in nature. The air passes rapidly into the blood and tends to dissolve in it to the same degree of excess in which it is present in the water. In other words, the osmotic pressures on the two sides of the gill membrane tend to equalize. The blood as it streams through the gills becomes, like the water, supersaturated with air, probably with nitrogen as well as with oxygen, although the latter only is concerned in ordinary respiration. But so far the air is still in solution and not free in the vessels. What precipitates it? Two causes tend to this result, one the presence of corpuscles, the other and probably more important being the higher temperature of the systematic circulation of the fish. While fishes are cold blooded animals, they nevertheless

are slightly warmer than the surrounding water. This may be inferred from the fact of oxidation in living animals, and direct observations have corroborated it. In the thin gill filaments the blood must cool to substantially the temperature of the water. But after leaving them, oxidation occasions a slight warming. In this warmer blood gas is less soluble and some of the air must come out of solution as free bubbles. This process is continuous, and finally enough air accumulates to plug the circulation.

By subdividing the flow into very many fine streams the Woods Hole water could be deprived immediately of its excess of air and fishes would live in it without unusual symptoms. A simple apparatus, a dishpan with the bottom punched full of small holes and raised several feet above the tank it supplied to give the streams a fall, served this purpose. It is to be remarked that such an apparatus aerates water if it is lacking in dissolved air and deaerates it if it has an excess. The process tends toward a certain constant, which is the maximum amount of air the water will hold at the temperature and pressure existing.

The eggs and fry of the codfish were not affected by this water which was fatal to adult cod or adults of any species. This is a rather remarkable and interesting fact. It is true that while the eggs are in this water during almost the whole period of incubation—some two weeks—the fry are in it only a few hours or at most a few days. They are planted very soon after hatching, yet they often remain in the water for a period which would be fatal to adults, without appearing to be injured. The explanation is to be looked for in their very different organization from that of the adult. A newly hatched fry is far from being a full fledged fish in other respects than size, and we can hardly suppose it to maintain a temperature appreciably above that of the surrounding water. This would remove the chief cause which tends to release the gas once dissolved within the blood.

The general features of this mortality present three salient particulars. First, its severity. In the degree of supersaturation existing at Woods Hole it was absolutely fatal. There was no resisting the fatal outcome, no treatment or remedy while fishes were within the affected water could be of any avail. With even the hardiest and least susceptible species—the mummichog—it was merely a question of time. Secondly, the simplicity of the

original cause and of the mechanical process which usually is the immediate occasion of death. Leaks in a pipe were at the bottom of the whole trouble, and the leaks introduced nothing more remarkable than air. Parasites, bacterial or otherwise, are not concerned; but purely physical causes alone, the laws of which have long been known. Thirdly, the essential and active agent, air, which alone is the immediate cause of death, is one whose lesser constituent, oxygen, is absolutely necessary to the life of fishes and of most living things. The mortality is a conspicuous example of too much of a good thing. Without entering into, partly from ignorance, the separate roles played by the oxygen and nitrogen of the air in respiration in fishes, it may be remarked that the respiratory mechanism is nicely adjusted to water containing air the amount of which is within certain limits,—on the one hand enough to barely oxidize the blood, on the other to the point of saturation. Below one limit and suffocation results; above the other limit and, strangely enough, suffocation may result also, but more indirectly, first mechanically stopping the circulation. Between these limits all fish cultural operations, with adults at least, whether of nature or by artifice, must be carried on.

It must not be supposed that nature always avoids surpassing either of these limits. It is well known that springs are apt to deliver water lacking in air,—not well aerated. On the other hand, wherever it is possible for air to accompany spring waters through any part of their course, it will pass into solution according to the depth at which their air is present. This may of course be considerable and some springs do give forth water containing an actual excess of dissolved air. The degree of excess is doubtless much less than that of the Woods Hole water. In these cases air will usually be seen to bubble intermittently from the spring bottom. As the water flows away from such a spring, the excess passes off and the water soon corrects itself.

The Woods Hole occurrence impresses upon fish culturists and managers of large aquaria the fact that where pumps supply the head for the gravity system, a danger constantly menaces. It may remain in abeyance and never do any damage. If the suction pipe is intact—quite impervious—where it is not under water, and no free air can be taken up with the water at the point

of intake, all will be well. If the suction pipe is of wood, very slight breaks or a general porosity may develop as the wood decays, a condition which may not be noticed since air leaks *in* instead of water leaking *out*. The first entrance of air will probably be small in amount and make only moderate trouble with the stock of fishes, a trouble which would not readily refer itself to its real cause. Very slowly and gradually these leaks increase and the mortality becomes gradually and insidiously more serious, until the water kills all fishes soon after they are placed within it. This insidious progress has aided in obscuring the real nature of the mortality.

DISCUSSION.

Mr. Atkins: I would like to inquire whether there is any ready means of measuring the amount of air in water and ascertaining by any sort of observation, so that we can know when there is an excess.

Mr. Marsh: A chemical determination will show, but it is rather lengthy and involved. I do not know any very ready means except this. You can take two glass stoppered bottles, where the stopper fits perfectly, and fill one absolutely full of some ordinary water, and insert the stopper so that there are no bubbles whatever, letting it stand until any bubbles that may be in it are dissipated, insert the stopper so that after it is in no bubbles will be seen; then take in the same way a sample of suspected water and put them together where it is warmer, or put them in a dish of warm water and let them come up to the same temperature. Then in the case of the one that has the most air there will separate from it the greater amount of air; you can see which bubble is the larger. You can get a rough idea that way.

Mr. Atkins: Perhaps that is close enough for practical use.

Mr. Marsh: I would try it. If from such a bottle there separated no more gas than from a bottle of water I knew contained no excess, the inference could easily be drawn that there was no excess in the suspected water. If the bubbles were larger it might merely be better aerated.

General Bryant: Was this water sea water?

Mr. Marsh: Yes, sir.

General Bryant: Do the same conditions ever arise in fresh water?

Mr. Marsh: Yes, sir. If you have a mechanical plant like the one here, and were pumping fresh water, there is no reason why the fresh water would not become saturated in the same way.

General Bryant: Have you any instances of fish suffering from this condition except in salt water?

Mr. Marsh: I have no doubt that there are such instances, yes, sir.

Mr. Titcomb: I think this paper is especially valuable, and possibly the fish culturists have not all appreciated it, regarding the point I am going to bring out, and General Bryant's inquiry would naturally bring it out. Here at this station the question is easily solved by having tight suction pipes, no leakage to admit air, but it appears that springs sometimes contain an excess of air: Now, the fish culturist ordinarily in looking for a location for a hatchery for an eyeing station will examine the spring and will question whether the water contains sufficient air. It seems that we have got to guard against superabundance of air in the same way. We have in the commission one station today suffering from an excess of air coming right into the spring. The air bubbles up and rise up through the spring to the surface of the water—that is the station at Erwin, Tennessee where Mr. Jones is superintendent, and we have had serious trouble with the fry before Mr. Marsh made some investigations and solved the problem there as he has here. There we can probably arrange matters so that the water will be all right in the hatchery by the same treatment that we would give water which lacked air—aerate the water by passing it over a series of falls. Unfortunately at this station the fall is not very great between the springs and the hatchery.

Mr. Nevin: In our hatchery between the spring pond and hatching house there is a distance of twenty-five feet, and the fry in the troughs do not do so well as in the main hatching building, or main pond, and that is on account of the excess of air.

Mr. Marsh: How does it get in?

Mr. Nevin: I don't know.

Mr. Marsh: Unless the air in the spring bubbles up from the bottom and presumably from quite a depth.

Mr. Nevin: There is probably nine feet of water in the pond.

Mr. Titcomb: Are there springs in the pond?

Mr. Nevin: Yes, sir.

Mr. Marsh: Is there bubbling of gas all the time?

Mr. Nevin: No.

Mr. Marsh: If that water could take up air only from the surface I do not see how it could get an excess. Is there any agitation in the water?

Mr. Nevin: No, none at all.

Q. Do the bubbles adhere loosely to the fish?

A. Yes.

Q. Can you see the bubbles in the water?

A. No, not loose in the water—I noticed them on the fish in the aquarium also.

Mr. Marsh: Those bubbles may not be due to excess—it may be an entirely different matter—I do not see how in this case there could be an excess of air.

Dr. Bean: I would like to ask whether a paper on this subject was not published in the Transactions, growing out of investigations on Long Island—a paper about two or three years ago, based on some observations at Cold Spring Harbor.

Mr. Marsh: In the fisheries transactions?

Dr. Bean: They are in the Fisheries Society's publication or in a Bulletin of the Fish Commission—I think I have seen a paper of that kind on the gas bubble disease.

Mr. Marsh: Yes, in the bulletin of the fish commission, and Prof. Gorman, the author of the article, is present tonight and perhaps may mention it. In that article he refers to the popeyed scup at Woods Hole, and there are specimens of them in the aquarium here now. As I said, that popeye I did not see here in the winter. The popeye that they have in the summer may be due to the same cause and may not—I do not know. Prof. Gorham's explanation was one of reduction of pressure, the scup having been taken from deep water and put in shallow aquaria. If there is a little gas in the tissue behind the eye it

expands and pushes the eye out, the scup being particularly adapted to that occurrence.

Dr. Bean: I did not have that in mind, but it appears to me something was published a few years ago about a similar condition of trout on Long Island.

Mr. Marsh: I think in the report of the New York State Fish Commission for 1897 or 1898 there is a report by Prof. Calkins on an epidemic in trout on Long Island, but there was no gas concerned in it. It was due to a protozoan, Lymphosporidium, which killed the trout in great numbers.

Mr. Clark: Prof. Marsh has presented a very interesting paper; and to confirm what he states there in regard to the aeration system, taking the air out of the water, I might state a little experience I had quite a few years ago, I think in 1875, 1876 or 1877, with some rainbow trout I was transferring from Northville to Geneva Lake for Mr. Fairbank, of Chicago, the lard man who died a short time ago.

He was spending quite a considerable amount of money in that lake, and Prof. Baird gave him some rainbow trout which were hatched at Northville, and I took them there myself. I had my fish rather thick in the can and was having a little trouble before I reached Chicago. However, I got them there without any great loss and immediately hurried my fish to the hydrant at the end of the Illinois Central depot, and paid a boy fifty cents to help me get fresh water to the trout, and I drew out one pail of water and put in a fresh pail, and before I got quarter around the fish were doing badly in the first can, and there were ten cans altogether. They were coming up and turning and making a great fuss. I kept giving them fresh water and my fish kept acting badly all the time. I knew there was something wrong, and I immediately commenced drawing the water off and stirring it and putting it back, and in less than an hour and a half I had my fish in good condition. I stopped using Lake Michigan water, and from that day to this I could not account for it; but Prof. Marsh has solved the problem. I knew there was too much air but I did not know why. Deaeration helped them, but I took the air out of the water instead of putting more air in.

Mr. Ravenel: Was this fresh water that you put in overcharged with air?

Mr. Clark: Oh, yes.

Mr. Ravenel: The mere pouring in of the water could not have been injurious?

Mr. Clark: No; because by the time I kept changing this water I had got pretty near all Lake Michigan water. You could see the air right in the water. Perhaps it is not so thoroughly charged with the air, but you could see the air in the water; but solved the problem to my satisfaction, and the explanation is that there was too much air in that water for those fish, and had I continued giving it to them I would have killed the fish. I could not understand the reason of the trouble at that time, only that we had too much of that kind of air, and now I see the problem that he brings up here is that you take the air out by deaeration, and I took the air out at that time by the stirring process.

Prof. F. P. Gorham: I am interested in the statement made by Mr. Marsh, because it is along the line upon which I worked some time ago. We must distinguish between two sorts of gas disease, the sort that Mr. Marsh describes, which undoubtedly is due to the superabundance of air in the water, and another gas disease which shows itself by the formation of gas bubbles in the tissues of the fish. These bubbles are behind the eyes, causing the "popeye," or under the epidermis of the fishes, causing the bubbles of gas which form on the fins. I think the second sort cannot be explained by the presence of too much air in the water. I do not see how you can get the air from the water, first into the blood and then out into the tissues of the fish to form the bubbles, without first killing the fish. The amount of air present in the blood vessels would soon kill the fish. A small bubble of air in the vessels will kill the animal almost immediately. The fishes which show the presence of "popeye" and large bubbles in the tissues, contain altogether too much air to have it produced in the blood vessels; it would have killed the fish at the very first. It seems to me that the explanation which I gave some five or six years ago accounted for the presence of the large amount of gas behind the eyes and in the tissues quite satisfactorily. The change in the pressure upon the gas in the air bladder of the fish, brought about by placing the fish in an aquarium allows the gas in the air bladder to expand, and it works itself out of the bladder through the tissues back of the eyes and into

the fins. According to the species of fish in which it occurs it appears in various ways. To test this, a week or two ago I arranged an aquarium here in the hatchery, according to the plan advised by Mr. Marsh, allowing the water to pass through his deaeration apparatus before passing into the aquarium, and put in a considerable number of fish. In other aquaria I put control fish to notice the difference. I found that the external bubbles which Mr. Marsh describes and the bubbles of gas in the blood vessels, do not appear in the fish which are in the water subjected to this deaeration process, but I do find the "popeye" occurring. There is a fish in No. 1 aquarium over there now in which the bubbles of gas are forming behind the eye in just the way they do in the other aquaria, so that it seems to me we are dealing with two sorts of gas disease here, and we ought to distinguish between the two.

Mr. Nevin: Did you ever see air bubbles on the rainbow trout and see them floating on their backs?

Mr. Marsh: No. At the time I was at Erwin there were no fry with sacs, and whether such fry had these gas bubbles or not I don't know.

Mr. Lydell: I would like to ask Mr. Marsh if it is possible to take an air pump and pump too much air into water for fish?

Mr. Marsh: I think that is purely a question of how deep the water is. In an ordinary can I do not think you could get sufficient excess to harm the fish at all; but if you had a can eighteen feet deep or perhaps not quite so deep, and pumped a continuous stream of air to the bottom, I believe it would kill all the fish in the can after a while; the pressure of this high column of water drives the air into the water in excess. The water in the ordinary fish can seldom has an excess. I think there is a depth of only two or three feet and that would make an additional pressure of only a pound and a half about.

Mr. Titcomb: I can give a little experience about this superabundance of air in aquaria in connection with the ordinary ones used in drug store windows. I know of two instances where a beautiful lot of trout on exhibition in an aquarium about six feet long by about two or three feet wide in a drug store window, were all killed. The first lot of trout suddenly jumped out onto the floor as if at a signal. The aquarium was restocked and covered,

and the second lot smothered in the aquarium; and you will find that in the ordinary city water supply, if you try to operate an aquarium, it is desirable to have a receptacle through which to pass the water in order to deaerate or regulate it, before it passes into the aquarium. If you pass it directly into the aquarium from the ordinary aqueduct supply, you will occasionally get this superabundance of air. It will come in big bubbles, and the fish will become uneasy immediately and dart about, getting out if they can. That was an experience I had a number of years ago.

Mr. Ravenel: I think that Mr. Marsh's paper is exceedingly interesting from the fact that I think he has explained the cause of our failure in Charleston, South Carolina, a year and a half ago. The Fish Commission used the same aquarium there that was used at Buffalo, except that the supply of salt water was drawn from a pond near by hand and pumped directly into the supply pipes just over the tanks. The suction pipe was a temporary affair and hastily put up under very adverse conditions, and although we did not notice any leaks, and we thought that every precaution had been taken to make the aquarium successful, several car loads of fish delivered in excellent condition died within from twenty-four to forty-eight hours. Later on we captured within a hundred yards of the aquarium, mullet squeatog and numbers of other fishes, and lost them almost as fast as we could put them into the aquarium. Mr. Marsh was sent down to investigate this matter, but before he arrived there the suction pipe had been changed from the pond and run to a distance of 500 feet to the end of the dock, so that when he got there the fish were not dying, and he had not seen the conditions that existed during the earlier part of the season. I discussed this matter with Mr. Marsh before his paper was read tonight, and I recollect very clearly that large numbers of the fish were covered with air bubbles, and after a while they began to swim zigzag around the aquarium, then they would turn around on their backs and swim on their backs for a while. Two carloads of these fish came from Tampa and one from along the Georgia coast. I am satisfied, bearing in mind the fact that the first suction pipe run was a temporary affair, that the water was supercharged with air, and I have no doubt at all but that the large death rate resulted therefrom. I must say, though, that I have also noticed the

same thing at previous expositions on a very small scale. We have never lost such very large numbers of fish as we did in Charleston, and it is very hard for me to recollect whether the fish that we lost in Buffalo which were apparently affected in the same way, were fresh or salt water; but I am under the impression that they were fresh water fish supplied by the New York State Fish Commission. I think that this occurred when Mr. Marsh was there, as he spent quite a time in Buffalo studying the fungus question.

Mr. Marsh: I do not remember any bubbles at Buffalo.

Mr. Atkins: It seems to me that I have seen recently in some publication, some method described for determining accurately either the amount of air or the amount of oxygen in water, and I think it must have been some German publication. I have only an indistinct impression about it, and if such a thing can really be devised or has been devised, it might be very useful in avoiding such troubles.*

Mr. Marsh: Is this a practical method for any one to employ?

Mr. Atkins: That is my impression.

Mr. Marsh: If there is I would like very much to find it. A chemist takes the water in a flask and boils all the gas out collects and determines it as a gas.

The members can look at the fish now in the aquaria and take note of what a difference the difference in temperature apparently makes. You can keep the fish in aquaria to some extent as you have all seen. There are fishes there and they are not dying all the time, though I suppose they are dying to some extent. The water is now much warmer, perhaps forty degrees warmer, than when I was here first. Then it was at the freezing point and sometimes below, and it holds the maximum amount of air then. Now, with forty degrees increase in temperature the excess of air will be much less, and it lowers the death rate very markedly. In one tank of the mummichog minnow, there are a great many fish, and you will see them with little blisters all over their fins, but they do not die every day. They have been lying there since Tuesday when I first saw them.

*Mr. Atkins later found the method referred to, described in the Allgemeine Fischerei-Zeitung, 1902, page 408.

Now, in the winter, although the mummichog was the most hardy species we had in the aquaria, still they would die rapidly. Some lived two or three weeks, but all died, and some would die in a very few days—much more rapidly than they do now.

I might add to that about the popeye, that I think there is even another sort of popeye than the one mentioned by Prof. Gorham. I remember one case at the Manchester station where the lake trout had the eye almost out of the head, and you could puncture the globe of the eye and see the evolution of gas. I do not know that there is any excess of air there. If not that would remove any explanation from that direction. Now, the pressure explanation could hardly apply to them, because they have been at that station all their lives and have never been in deep water. I understand they were hatched there; that popeye is due very likely to bacterial infection, producing gas.

THE GOLDEN TROUT.

W. T. THOMPSON.

I wish to state right in the beginning that it is not my intention to present to the society a complete study of the golden trout, but rather a slight sketch of one of the least known but most beautiful of New England's fishes. I had almost said "New England's indigenous fishes," but on this point there is still a difference of opinion. Should we make bold to claim this distinction, such claim would be promptly challenged by a considerable body of ichthyologists, headed by Mr. Samuel Garman of the Museum of Comparative Zoology, who claim it to be a descendant of the German saibling, though they fail to enlighten us as to when, and how, it was transplanted into our waters. On the other hand, an equally distinguished body of scientists, including such eminent authorities as Drs. Jordan, Bean, and Quackenbos, while admitting its resemblance to the European form, claim that it is strictly of American origin, and not a naturalized production.

Its natural range is extremely limited. A few waters in Maine in addition to Danhole Pond and Sunapee Lake in New Hampshire, would comprise about all the waters where it has been found. It is probable that it is best known, however, as an inhabitant of Sunapee Lake. Rumors reach us occasionally that the Dominion waters contain examples of this rare trout, but up to the present time this claim has not been substantiated, the *so-called* golden trout, though somewhat similar in appearance and habit, proving to be the Canadian red trout.

Without some reference to the picturesque and beautiful description of their most ardent champion, Dr. Quackenbos, any paper on the golden trout would be as distinctly lacking in flavor as a Woods Hole meeting of this Society without a Rhode Island clam bake, or as that good old clam bake without the jovial and humorous president of the Wisconsin Fish Commission to voice our appreciation of the feast in his own characteristic manner.

But to return to my description: "Throughout the spring and summer the back is dark sea-green blending on the sides

to a flashing silver, which in turn deepens below into a rich cream. But as the October pairing time approaches, the fish is metamorphosed into a creature of indescribable brilliancy. The nuptial coloration is gorgeous beyond example among our indigenous salmonidae, the deep purplish hue of the back and shoulders now seem to dissolve into a dreamy sheen of amethyst through which the inconspicuous pale lemon spots of midsummer flame out in points of lemon or vermillion fire, while below the lateral line, all is dazzling orange. The fins catch the hue of the adjacent parts and pectoral, ventral, anal and lower lobe of the cardal are ribboned with a broad white margin. Those who have seen the flashing hordes on the spawning beds, in all their glory of color and majesty of action, pronounce it a spectacle never to be forgotten."

Possibly a comparison with such a universally known fish as the brook trout will give many a clearer idea of its appearance. Head and mouth smaller, form more slender and tapering, back unmottled, in the adults, and spots without the blue aureola, tail more forked. The noticeably larger fins which lack the black stripe just inside the white border, are a delicate creamy yellow in color, though they appear a fleecy semi-transparent white edged with a clear shining ivory border. As they move quietly through the water with extended fins the general effect is airy and graceful in the extreme, reminding one of a beautiful yacht under full sail, and bearing the same relation, in appearance, to the ordinary trout as a cup defender does to a common cruiser.

There has been no systematic study made of the life history of this interesting variety. What little knowledge we have regarding it is not so much the result of direct investigation as a mere incident of the fish cultural work that has been carried on for some years past by the various commissions, the New Hampshire C[illegible]ing perhaps the pioneer in this direction, having operated at Sunapee Lake as far back as 1890. For much of my information along this line I am indebted to the courtesy of its preseident, Mr. Nathaniel Wentworth, who has had supervision of this special work for a number of years; also to his son, Mr. Edward Wentworth, who operated at Sunapee for the state for several years, and who has in connection with Mr. Dennis Winn carried on the field work with this variety for the past two

seasons for Superintendent Hubbard of the United States Fish Commission.

Speaking briefly, and with special reference to the Sunapee fish: They inhabit the depths of the lake during the entire year, where they are out of sight and beyond the range of our observation, with two brief exceptions. These exceptional occasions are the result of food, and spawning instincts. In the spring they follow the spawning smelt into the shallow shore waters. They reappear again the last of October, on the reefs surrounding the lighthouse, where they deposit their own spawn, occupying only a week or ten days in so doing. During this period their color is most gorgeous, all below the lateral line being a flaming golden orange, fully warranting their popular name, "Golden Trout." This season of high color is almost as brief as the spawning period, the brilliant hues dissolving quickly into the usual silver coat. So changed is its appearance thereby that they were then called the "White Trout," and by many were formerly supposed to be an entirely different variety.

Probably no other trout has so short a spawning season. This fact renders the usual difficulties and uncertainties of netting fish in such exposed localities especially exasperating. A single storm at the critical period causing a great falling off in the egg harvest, and possibly even a complete failure of the season's work. The beds are made on the small stones, in comparatively shallow water, say under five feet. But little preliminary notice is given of their coming. No van-guard of stragglers heralds their approach. They appear in a body and begin the spawning operations at once. The height of the season extends from the second to the fifth day. The females vary greatly as to size. Ranging upwards from the six and eight-inch fish, with the bars still showing, and weighing only a few ounces, to the matured specimen of three and four pounds, their average being probably in the vicinity of one and one-half pounds. Fully eighty per cent are ripe when taken from the nets. The number of males on the beds is much greater, probably in the proportion of three to one. They are considerably larger in size, few immature specimens being seen.

The saibling is a sinewy and powerful fish, is a hard and persistent fighter, during the entire spawning operation, ceasing its

struggles as the operator ceases, only to recommence with renewed vigor as he continues. Fortunately they have but little body slime; the scales are also moderately large, so that they are not so difficult to hold as they would otherwise be. There is a tendency to ovarian troubles, plugging, etc. Right in the midst of a free flow of eggs the vent may become as effectually plugged as though closed by a valve, though an abundant supply of eggs may still be plainly felt in the abdomen.

Prior to the present year there had usually been a difficulty in securing milt when actually needed to impregnate the eggs, though it flows freely while the males were being extricated from the nets. Heretofore the fish were placed in live boxes over night and spawned the next morning. The plan was varied the present season the spawning operations closing the night's work. The flow of milt was more abundant and of better quality, and as upwards of eighty per cent of the females were found to be ripe, there was an improvement both in quantity and quality of the eggs taken. This method has the additional advantage, that the spent fish are at once released without being unnecessarily injured by confinement in the live boxes.

Golden trout eggs do not stand transportation as well as those from the brook trout, either in the green or eyed stage. There is also greater loss amongst them during the various stages of incubation, whether as a result of imperfect impregnation, or arrested segmentation, I cannot say. The fry are somewhat longer and more slender than brook trout, and while the yoke sac is smaller, it is absorbed more slowly. I might also add that it is more completely absorbed before the fry can be induced to take food. In addition to the bars on the sides the shoulders and backs are irregularly covered with numerous black blotches of varying sizes and shapes.

The real difficulties in the way of propagation now appear. In fact, these difficulties are always appearing. Every fish culturist who has handled this variety has met with more or less failure, usually more. If there is a Mark Tapley among this membership I would suggest that this golden trout is the fish he is looking for. He can get all the honor and glory he wants.

Right now I want to emphasize three essential characteristic habits of the golden trout. At all stages of his existence he is a

bottom feeder. He inhabits deep and cold waters. It is only by bearing these facts in mind that the fish culturist can hope to achieve any measure of success. I have always been an ardent advocate of feeding fry frequently and slowly, and only so much at a time as they would eat while in suspension, allowing none to fall to the bottom and foul the trough. We fed golden trout fry on that theory for two years and if one judged by their appearance, *theory* was the only thing we did feed them on. It was not a success. The first crop did not begin to thrive until almost one year old. The next lot was distributed as fry. We began feeding the past season's crop on theory again, and with the usual result. Then we discarded theory and used liver alone, with gratifying success. These fry are peculiar acting little fellows. Toward the latter stages of the absorption period they become congregated at the upper end, heads up stream, laying so close together as to hide the bottom of the trough, and as still as though glued to it. Day after day passes with scarcely a movement or change on their part, except that their slender form grows thinner and thinner. Frequent light feedings attract but little attention, the particles being carried rapidly over the compact fish mass by the current without inducing a rise. Seemingly they have neither desire for food, nor ambition to live. The body fades to a mere line. In the subdued light of the hatching trough they appear all heads and eyes, presenting a decidedly uncanny appearance, to say the least. I can assure you we didn't enjoy the sensation caused by the sight of those fish fading away day by day and week by week; but what could we do about it? All other fry took their food readily and easily when the proper time came. Others had found this same difficulty. It was very evident that the fault was with the fish. Dead fish tell no tales; that is, unless you have a bacteriologist in your commission.

But, as I remarked before, we dropped the theory, counted out a trough for rearing purposes and began feeding liver thickly at the head of the trough, allowing it to fall to the bottom. We soon found that before the time for the next feed they had picked up a considerable amount of this food. Continuing this practice we soon had the fish in a thriving condition, fully equal to

our best brook trout fry, and realized that under proper conditions they were gross feeders and rapid growers.

When placed in the ponds they do not spread around as do most trout, but huddle in the dark corners darting erratically here and there whenever anyone approaches. It is necessary to wait until they become quiet and still in their usual location before throwing in the feed. Great care must be exercised in feeding only so much as they will pick up, as otherwise the pond would soon become foul. The fish now appear quite hardy, with no unusual tendency toward disease or fungus, but are very sensitive as to temperature. Our limited experience would indicate 55° as being the maximum to which they should be subjected, and a still lower one as being more desirable. If this condition can be met there need be no serious difficulty in rearing to the yearling stage, but beyond this the task becomes increasingly difficult. Few hatcheries have ponds of suitable size and depth, combined with proper temperature, to warrant any attempt to carry them to a greater age.

Before closing I wish to call attention to two peculiarities we have observed, first, our young fish have always been most active and healthy and have made the most rapid growth in the severe winter months, lessening in degree as spring approaches, when other salmonidae begin to thrive. This is probably due to the fact that the temperature and the subdued light of the short winter days most nearly approximate the conditions found at the depths they would ordinarily inhabit. The second is in connection with the marbling on the back. Our authorities all agree in telling us that this marbling is one of the marks by which it can be distinguished from the brook trout. Now it is one of the anomalous facts in connection with this fish that during a certain stage, intermediate, I may term it, this marbling is as plain as on the brook trout. During the second year, as the bars and blotches begin to fade, the marbling appears, apparently, as though it had been merely hidden from view by their more dense colors. Before attaining to full maturity these in turn fade from sight. The Canadian red trout is the only other fish, to my knowledge, that has this same peculiarity.

DISCUSSION OF MR. THOMPSON'S PAPER.

Near the beginning of his paper Mr. Thompson said: Since I have been aboard the Fish Hawk, I have had some conversation with Dr. Bean on the subject, he tells me that this variety was found here before there was any fish cultural work done in the United States. Such being the case, it is highly improbable that any specimens of the European saibling should have been received and successfully transplanted into American waters. This seems a very strong point in determining this question of origin.

Mr. Carter: I think Mr. Thompson spoke of the golden trout being found in the waters of New Hampshire and Maine only. They are also found in Northern Vermont; they are indigenous there and are found more abundantly in Little Averill pond than anywhere in the United States.

Mr. Thompson: I knew they were found there, but had the impression that they were transplanted.

Dr. Bean: This paper of Mr. Thompson's has interested me very greatly, and although its right to bear a distinct name has been challenged by Mr. Garman, what the author of this paper has written has given me a great deal of satisfaction, and I am also very glad to learn that the golden trout is native to other waters than those of Maine and New Hampshire—that is to be expected. Gentlemen, you know that the trout and salmon, numbering as they do about one hundred kinds of fish, as far as we know at present, are so little differentiated even today, that the experts differ in their notions as to what is a species and what is merely a local race. We know very little about the salmon, notwithstanding the investigations of the Fish Commissions of various countries. We know that they are widespread, that they are abundant in individuals, that they have curious life histories, varying with different climates, but as to the points in which they differ one from the other and may be recognized by the average man, there is no consensus of opinion. I doubt if there is a man today who can even tell whether the salmon originated in fresh water or in the sea. It is true that the Canadian Geological Survey found what appears to be a Pacific salmon in

the clay shales of the Thompson river in British Columbia. I do not know whether this has been published or not, but it is a fact that a fossil nearly like the present well-known Pacific salmon, represented by a few individuals was taken in that river. Now, it may be that the fish originated in the fresh water, and if so the idiosyncrasies of its character will be better understood. We all know that of this type of saibling we have knowledge of at least half a dozen species beginning in the high north with the Floeberg char, then the Greenland char, extending to Labrador, and the red trout of Canada, the silver trout or golden trout or white trout of Maine, Vermont and New Hampshire, the blue-back of Maine, the Dolly Varden of the west, the white-spotted char of Kamchatka—those are all saiblings—and of course the well-known European saibling, over which a good deal of controversy has arisen, but which I believe has been taken with certainty in only one lake in the United States since its introduction, and that is Sterling Lake in New Jersey and New York; so that there is quite an array even of saibling that we know about. Now, if we could extend this inquiry to the fish that we do not know about, perhaps we would be as much surprised as the deep sea investigators of the United States Fish Commission are whenever they make a cruise. We have to deal only with what we know, and we know so little that I welcome this paper of Mr. Thompson as a distinct addition to our knowledge. We did not even know that this fish was marbled; we did know about the parr-marks, but the marbling is something new, and in that respect it brings it still closer to the brook trout. Of course the real distinction between brook trout, and the saibling, as you know, is an anatomical one, all the saiblings having a forked tail and all the brook trout having what is called a square tail; and the saiblings all have a little patch of teeth at the root of the tongue, which the brook trout, with some exceptions, lack. I am glad that this paper has been presented, and I know that it will be greatly valued by all who have heard it. (Applause).

Mr. Thompson: I would like to say that we have at the Nashua station some hybrids of the golden trout and the brook trout—the eggs of the golden trout being fertilized with the milt of the brook trout. These were eggs taken at the latter end of the season, we had no suitable milter amongst the golden trout,

so used milt of the brook trout. These fish are now upwards of a year old and show to a certain extent the characteristics of both parents. They have to a lesser degree than the brook trout the black line inside of the white margin on the fins. As to the marbling, of course we cannot tell whether that will disappear or not, but it is very plain now. They are not quite so slender as the saiblings but are more slender than the brook trout, and are very uniform in appearance—almost as uniform as any of the species. There is not a very great difference as to size—not more so than would be found amongst any fish of the same age. They do not feed in quite as great a depth of water as the golden trout, and yet lower than the brook trout. Our golden trout in the ponds, as I stated in my paper, huddle in some dark corner. The ponds we have kept them in have plank bottom, covered with sand, and they swim so low that in a very few days the movement of the fins brushes that sand all away, leaving the bare surface of the boards exposed. While our hybrids swim in much the same manner, they do not work the sand off so quickly, they have partaken almost equally of the characteristics of each of the parents, and show very decided resemblance to each of them, being half way between the two varieties, and I think it would perhaps be interesting for some of our scientists, if they would examine them more critically than we fish culturists can.

Mr. Nevin: What is the fact as to the shedding of teeth during the spawning season?

Dr. Bean: I heard it reported frequently, but I have never made the observation myself. Of course the shedding of teeth during the breeding season is not at all uncommon. Many fishes do that.

Mr. Nevin: They do not do it during the breeding season.

Dr. Bean: The pike-like fishes and salmon are not very far apart in a good many respects, and I should expect to find that the pike and muscalonge, which belong to the same family, would show much the same habit as some of the salmon—that appears to be related to the spawning time.

Mr. Waterhouse: Can that hybrid trout breed?

Dr. Bean: Oh, yes, it is quite fertile, and so is the cross between the brook and the lake trout, but they are so closely related generically that there is no reason why they should not be.

Mr. Nevin: We have had quite a number in our pond, and they never bred.

Dr. Bean: Pennsylvania has bred many of them and got eggs from them.

Mr. Thompson: Some of the European culturists advertise hybrids 7-8—that would indicate two crossings with the hybrid.

Dr. Bean: I believe the rule so far as known is this, where a small-scaled fish of the salmon family is crossed with a large-scaled fish, the cross is never fertile, but if a large-scaled fish is interbred with a large-scaled and a small-scaled with a small-scaled fish, within the limits of the genus, the cross is always fertile.

Mr. Nevin: There is no cross between the brown trout and the brook trout?

Dr. Bean: No, because the brook trout is small-scaled. The scales are so small that many people think they have no scales, and the brown trout is a large-scaled fish.

Mr. Waterhouse: Is that a matter of theory or settled by experiment?

Dr. Bean: Settled by experiment.

SOME NOTES ON FISH FOOD IN THE LAKES OF THE SIERRAS.

BY H. B. WARD.

During the month of June of this year I had the privilege of spending some time at Glen Alpine Springs, California, which is located in the Sierras, close to a series of lakes of considerable altitude. A cursory biological examination of these lakes disclosed biological conditions which may be of considerable interest to members of this Society. What may have been the early condition of the lakes, I do not know, but from the precipitous character of outlets and the long stretches intervening between them and other waters, together with the limited amount of outflow, it seems impossible for fish to gain a footing. From time to time, however, within recent years, plants of trout have been made in these lakes with varying degrees of success. There are consequently two questions which will come at once to the minds of all members of the Society; first, what is the source and character of the food on which these forms have subsisted? Second, how far have they adapted themselves to their environment in the process of becoming a permanent part of it? Although the study could not be extensive in the time at my disposal, even a brief survey disclosed some features of considerable interest, which I desire to present in tentative form at this time.

A few words regarding the lakes themselves may not be out of place. They are all located near the southeast corner of Lake Tahoe, and empty their waters ultimately into that lake, through the medium of a smaller body known as Fallen Leaf Lake; the latter is located directly south of the main lake, and separated from it only by a low alluvial plain not quite two miles in width, so that one may regard this smaller lake as but a branch of the larger one. Following the inlet of Fallen Leaf Lake, upward and away from this body of water, the valley ascends very rapidly and the channel of the brook is little more than a succession of rapids and falls, in some cases of considerable height. The amount of water in it during the early part of the year, while the snows of

the higher regions are melting, is considerable, but is said to dwindle markedly later in the summer. In the course of this brook and its branches are located the half dozen smaller lakes which were the particular objects of this study. They are known locally as Grass Lake, Lily Lake, Suzy Lake, Heather Lake, Half Moon Lake, Gilmore Lake, and their similarity is rather striking. In size, from a quarter to a half mile in length, they are for the most part deep pockets with little or no shore area and vegetation, and with the major portion of the margin and bottom of rock formation. In altitude they vary from 6,300 feet to about 8,000 feet. At the time of the visit the lower lakes were entirely free from ice and snow, and the water had risen at the most favorable points to a temperature of sixty to seventy degrees, although this obtained only over limited areas of surface water. At the same time the upper lakes were still ice-bound in part and fed exclusively by mountain snow banks, so that the temperature of the water was everyhere low.

I made a series of collections, both from the shore and deep water in these lakes, and the result of the same is shown in the table at the close of the paper. It was indeed remarkable that the lakes contained so little in the form of microscopic life. Neither plant nor animal forms seemed to be present in considerable numbers or in any variety. A few of a single species of entomostracan was all that any lake contributed from this group, while in some not a single member of it was captured. Apparently, then, at this season the microscopic crustacea can afford little or nothing in the way of food supply for the lakes. In shallower pools adjacent and sometimes connected with the larger lakes I found numbers of these forms; but still more numerous and striking was the development of insect larvae. These collections are also noted in the table. The trout which were caught in the different lakes varied greatly in robustness. From certain lakes they came plump and well fed; from others, however, the fishermen reported that they were "all head," having had a hard time during the winter, and being thin and poorly nourished at present, a fact which stands in interesting connection with the absence of the plankton organisms from these lakes.

One other interesting fact deserves mention in this connection. I was privileged to examine the stomach contents of a

duck which had been collected from one of these lakes for the United States National Museum, and noted here also the absolute want of those small crustacea which elsewhere form so large a part of the food of these aquatic birds. Practically the entire mass of stomach contents was composed of mature insects with a few larvae, and this agreed fully with the observations regarding the food of trout. The insects had apparently pushed into these regions from lower altitudes at a date in advance of the development of the local fauna. They were present in the region in considerable numbers, the trout were taking the fly eagerly and were voracious after grubs and larvae. It is a fair question, then, whether under such circumstances the problem of support for the trout is not simply an entomological one. Of course, one must recognize clearly the insufficiency of such brief and scanty observations, but the universal testimony of the series of collections cannot help being suggestive.

Regarding the question of the adaptation of the animals to their environment, I have only one observation to record. At Gilmore Lake, for instance, the various sources of inflow are so scanty in volume, and so precipitous that even at this season of maximum intensity, they could not, without considerable local interference, be made available as spawning grounds for the fish. The latter must consequently spawn in the main lake, if at all. The same can be said of some, though not all of the other lakes. It is the firm belief of those residents best qualified to testify that the fish have established themselves, and it would certainly be most important to determine precisely in what way this has been done. In fact the biological problems suggested are of the greatest economic importance and scientific interest, and afford some probability of their solution in the sharply limited territory which is concerned as well as the virgin character of the water previous to the introduction of the fish. A more careful and extended study of the region would furnish data of value for practical fish culture, and of scientific interest as well.

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Orr, W. J., Bay Port, Mich.
Osborn, William, Duluth, Minn.

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Pike, Robert G., Middletown, Conn.
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Peck, Hon. Geo. W., Milwaukee, Wis.
South Side Sportsmen's Club, Oakdale, L. I., N. Y.
Sweeny, Dr. R. O., Lester Park, Duluth, Minn.
The President of the United States.
The Governors of the Several States.
Woodmont Rod and Gun Club, Washington, D. C.
Cortelyou, Hon. Geo. B., Washington, D. C.

CORRESPONDING.

Apostolides, Prof. Nicoly Chr., Athens, Greece.
Armistead, J. J., Dumfries, Scotland.
Birbeck, Edward, Esq., M. P., London, England.
Brady, Thos. F., Esq., Inspector of Fisheries, Dublin Castle, Dublin, Ireland.
Calderwood, W. L., Esq., Inspector of Salmon Fisheries, Edinburgh, Scotland.
Feddersen, Arthur, Copenhagen, Denmark.
Feilding, J. B., Upper Downing, Holywell, North Wales.
Giglioli, Prof. Enrico H., Florence Italy.

Ito, K., Member of Fisheries Department of Hokkaido and President of the Fisheries Society of Northern Japan, Sapporo, Japan.

Jaffe, S., Osnabruck, Germany.

Juel, Capt. N., R. N., President of the Society for the Development of Norwegian Fisheries, Bergen, Norway.

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Maccleay, William, President of the Fisheries Commission of New South Wales, Sydney, N. S. W.

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Olsen, O. T., Grimsby, England.

Sars, Prof. G. O., Government Inspector of Fisheries, Christiania, Norway.

Smitt, Prof. F. A., Stockholm, Sweden.

Solsky, Baron N. de, Director of the Imperial Agricultural Museum, St. Petersburg, Russia.

Trybom, Dr. Filip, Stockholm, Sweden.

RECAPITULATION.

Active	386
Honorary	55
Corresponding	20
Total membership	**461**

CONSTITUTION

(As amended to date).

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be American Fisheries Society. Its objects shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relting to the fisheries; the uniting and encouraging of all the interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of one dollar, become a member of this Society. In case members do not pay their fees, which shall be one dollar per year, after the first year and are delinquent for two years, they shall be notified by the Treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice President, who shall be ineligible for election to the same office until a year after the expiration of their term; a Corresponding

Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting or, in default of such action, by the Executive Committee.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the President.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussions of same.
   (Note—a. In the reading of papers preference shall be given to members present.
   b. The President and two Secretaries are empowered to arrange the papers of the meetings of the Society).
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said meeting.